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ABSTRACT

This study presents research into the reform in school curriculum programs in Iowa for mathematics and science being implemented by the National Council of Teachers of Mathematics and the National Research Council. Outcomes of the study include: (1) a status report about teachers' concerns regarding adoption of the mathematics/science curriculum reform; (2) research data regarding gender, years of teaching, educational background, level of teaching, participation in mathematics education organizations, and philosophical alignment with reform issues; and (3) feedback to curriculum directors regarding intervention strategies to assist teachers in adopting reform. Data was collected from a sample of secondary and middle school mathematics and science teachers, as well as teachers of grades K-4. A large number of mathematics teachers expressed negative attitudes toward the reform effort due in part to lack of resources and administrative support. Science teachers had more positive attitudes toward reform. Teachers active in state or national mathematics or science organizations are more successfully implementing curriculum reform and have more positive attitudes toward the effort. (AIM)

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1995 Implementation Status of Mathematics and Science Reform in Iowa: Based on Teachers' Concerns, Professional Activitiy, and Philosophical Beliefs

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1995 Implementation Status of Mathematics and Science Curriculum Reform in Iowa: Based on Teachers' Concerns, Professional Activity, and Philosophical Beliefs

Abstract

Patsy J. Fagan

The National Council of Teachers of Mathematics (NCTM) and the National Research Council (NRC) are working to implement reform in school curriculum programs. As implementation progresses, a crucial need exists for monitoring the implementation status and designing appropriate intervention strategies. Three research questions drove the need for this study: (1) What progress has been made in implementing mathematics reform with regard to teachers' concerns?, (2) What are the concerns of science teachers regarding science curriculum reform?, (3) Is there a significant relationship between a participant's stage of concern and years of teaching experience, grade level taught, educational background, gender, level of participation in mathematics/science education organizations and/or philosophical alignment with and content knowledge of reform issues? The outcomes anticipated from this study are: 1) A status report about teachers' concerns regarding adoption of the mathematics/science curriculum reform; 2) Research data regarding gender, years of teaching, educational background, level of teaching, level of participation in mathematics education organizations, and philosophical alignment with and content knowledge of curriculum reform issues; and 3) Feedback to curriculum directors regarding appropriate intervention strategies to assist teachers in adopting the reform.

Data were collected from a stratified random sample of secondary and middle school/junior high mathematics and science teachers, a set of grades K-4 teachers for each of mathematics and science, and mathematics and science teachers who participated in the model classroom project. A total of 1858 questionnaires were mailed: 1500 teachers were selected from the Department of Education list to participate in either the mathematics group (750) or the science group (750) and 358 teachers from the modeling classroom project received questionnaires for their respective disciplines (179 mathematics, 179 science). The overall return rate was 38.7%. The Stages of Concern Questionnaire (SoCQ) from the Concerns-Based Adoption Model (CBAM) was used to identify the concerns.

The seven stages of concerns were grouped into four categories: Awareness/Information, Self, Task, and Impact. For mathematics teachers, results indicate a majority of Self, Task, or Impact concerns. A disconcerting observance of the study, though, is the preponderance of negative attitudes. The science teachers' concerns were centered more on Awareness/Information, and Self.

Overall, for mathematics and science teachers, significant relationships exist between expressed concerns and years of experience, nature of college degree, professional development, and recency of educational experience. Teachers who participate in professional organization activities and who have a philosophical beliefs that align with the beliefs held by the NCTM and/or NRC are more likely to express higher concerns and a positive attitude

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1995 Implementation Status of Mathematics and Science Curriculum Reform in Iowa: Based on Teachers' Concerns, Professional Activity, and Philosophical Beliefs

PURPOSE OF THE STUDY

The *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989), the *Professional Standards for Teaching Mathematics* (NCTM, 1991), the *Assessment Standards for School Mathematics* (NCTM, 1995), and the supporting addenda materials present the philosophical foundation of the current reform effort and provide a description of quality mathematics programs that would fulfill the goals and objectives of the Standards. Since the publication of these documents, much effort has been expended at the K-16 levels to rewrite mathematics curricula that reflect the described vision. Many similarities exist between the current reform effort and the last national education reform effort of the 1960s. One is the focus on all components of teaching and learning: the process (teaching and assessment strategies) and product (curriculum) of school mathematics programs. Another is the need for a philosophical shift in what it means to learn and, hence, to teach mathematics.

A third similarity is a need for a plan to bring about successful implementation. Unfortunately, the initiators of the 1960s New Math effort failed to attend to this need and, despite the new content and new strategies, the effort is remembered as a great failure. The perceived failure, however, was not in the introduction of topics from the higher grades into the lower grades (e.g., set theory, functions) or the discovery method of teaching. These ideas have remained in the curriculum long after the pronounced failure of the movement. The perceived failure of the effort was in the lack of a successful implementation plan.

The impact of the school mathematics reform effort on educational reforms in all academic disciplines at the K-12 and the postsecondary levels is evidenced in the parallel recommendations for science reform initiated by the American Association for the Advancement of Science (AAAS) Project 2061 and the National Science Teachers Association (NSTA) Scope, Sequence, and Coordination

(SS & C) project. The *National Science Education Standards* (National Research Council, 1996) describes changes in teaching and professional development for teachers that are similar to the National Council of Teachers of Mathematics (NCTM) Standards. Similar strategies, therefore, are needed to ensure successful implementation.

A major aspect of the current reform effort is an adjustment in belief of what it is to teach and learn mathematics. Actively engaging the student in the learning process, appropriately using technology, and assessing conceptual understanding with alternative means are a few of the shifts that have occurred regarding mathematics teaching and learning. Implementing changes such as these requires, for some teachers, an adjustment to an established belief system and/or a shift in paradigm. Change is a highly personal experience (Hord, Rutherford, Austin, & Hall, 1987). Each person reacts differently to the experience. The change process, therefore, must carefully consider all key players (teachers, administrators, parents, students, and all members of a community who are affected by the change) in the implementation phase. The consequence of the alternative is a replication of the 1960s outcome: perceived failure of the entire reform effort.

The reform's philosophical nature requires an implementation plan that first identifies each player's stage of concern then designs appropriate intervention strategies that best addresses the concerns. A three to five year plan is necessary for the key players to make the shifts and to build a sense of ownership with the reform issues. Research indicates that failure to attend to these concerns in an appropriate manner will, in effect, fixate the individual at the identified stage and stymie adoption of the innovation (Hall & Hord, 1987).

The most significant research of teachers' attitudes and concerns in educational change was conducted in the early 1970s by the Procedures for Adopting Educational Innovations (PAEI) Program at the Research and Development Center for Teacher Education at the University of Texas at Austin. The result of a four-year study by the PAEI was the Concerns-Based Adoption Model (CBAM): a conceptualization of the way the concerns of individual teachers change as they become familiar with and involved with new programs, processes, or educational practices in their schools (Hall, Wallace, & Dossett, 1973). Based on Frances Fuller's (1969) research of the concerns of student teachers, CBAM approaches educational change as a process of resolving the concerns of the persons involved. While working with preservice, novice, and experienced teachers, Fuller realized a difference in expressed concerns from each group. When asked about their immediate concerns, preservice teachers typically responded with non-teaching concerns such as weekend plans, trouble with roommates, etc. Novice teachers expressed concerns focused on their feelings of unpreparedness or lack of ability to deal with discipline problems. They also were concerned with whether of not they would be liked by their students and/or would be able to mange their time. Experienced teachers, on the other hand, shared concerns of student understanding, working with colleagues, and making changes in the system to improve student understanding.

Fuller's research was instrumental in the development of the Stages of Concern (SoC) component of the Concerns-Based Adoption Model. Using her observations, seven Stages of Concern were identified by the developers (see Figure 1). The purpose of CBAM is to diagnose and identify an individual's stage(s) of concerns and then prescribe appropriate interventions (e.g., inservice workshops). The observable result is successful implementation as evidenced by resolution of lower levels of concerns and movement toward higher levels of concerns (Hall & George, 1979). Although a person does not necessarily progress through the stages in a linear fashion, there is evidence that lower concerns are resolved as higher concerns are being aroused. It is also possible for a teacher to jump between stages and report non-consecutive concerns; e.g., high personal (Stage 3) concerns and collaboration (Stage 6) concerns expressed at the same time. Analysis of multiple-peak profiles is aided by a personal interview with the teacher and/or a written statement responding to the question, "When I think about my involvement with [innovation], I am concerned about . . . . A major consideration in the use of the SoC is the highly subjective nature of self-reporting data regarding one's feelings, beliefs, and concerns. A valid question is the reliability of data over time; that is, would the data report the same teacher concern on a different day. CBAM research has shown that despite this weakness, SoC is a valid of measure of teachers' feelings and concerns and

STAGES OF CONCERN

1990 Categories	1995 Categories		
Impact 7	Impact 7	Refocusing:	The focus is on exploration of more universal benefits from the innovation, including the possibility of major changes or replacement with a more powerful alternative. Individual has definite ideas about alternatives to the proposed or existing form of the innovation.
6	6	Collaboration:	The focus is on coordination and cooperation with others regarding use of the innovation.
5	5	Consequence:	Attention focuses on impact of the innovation on students in his/her immediate sphere of influence. The focus is on relevance of the innovation for students, evaluation of student outcomes, including performance and competencies, and changes needed to increase student outcomes.
Tasks 4	Tasks 4	Management:	Attention is focused on the processes and tasks of using the innovation and the best use of information and resources. Issues related to efficiency, organizing, managing, scheduling, and time demands are utmost.
Self-Positive / Self-Threatened 3	Self 3	Personal:	Individual is uncertain about the demands of the innovation, his/her inadequacy to meet those demands, and his/her role in relation to the reward structure of the organization, decision making, and consideration of potential conflicts with existing structures or personal commitment. Financial or status implication of the program for self and colleagues may also be reflected.
2	Awareness /Information 2	Informational:	A general awareness of the innovation and interest in learning more detail about it is indicated. The person seems to be unworried about himself/herself in relation to the innovation. She/he is interested in substantive aspects of the innovation in a selfless manner such as general characteristics, effects, and requirements for use.
Unrelated 1	1	Unrelated:	Little concern about or involvement with the innovation is indicated.

Figure 1. Stages of concern about the innovation (Adapted by permission from Hall and S. M. Hord, 1987, p.60

can be used as a longitudinal measure of implementation progress. The Stages of Concern Questionnaire (SoCQ) of the Concerns-Based Adoption Model (CBAM) is the survey instrument that is used to gather the data.

When the NCTM first conceived of the current reform effort, a primary concern was that this effort would be more successful than the 1960s reform effort. As the seventh year of implementation approaches, a monitor of implementation status is necessary to identity concerns of teachers involved in the effort and to make appropriate adjustments to the implementation strategy that address the concerns. The SoCQ does not reveal what is happening in the classroom. The strength of the instrument is its use to describe the teachers' personal concerns regarding their role in the implementation process and in a longitudinal study to measure implementation status. A comparison with an initial study conducted in 1990 (Fagan, 1991) provides information to determine if progress has been made with secondary mathematics teachers. The current study provides additional information on the implementation progress of secondary teachers as well as initial information on elementary and middle school teachers. This is an initial study to gather baseline information on K-12 teachers who teach science.

GOALS OF THE STUDY

Three research questions drove the need for this study: (1) What progress has been made in implementing mathematics reform with regard to teachers' concerns?, (2) What are the concerns of science teachers regarding science curriculum reform?, (3) Is there a significant relationship between a participant's stage of concern and years of teaching experience, grade level taught, educational background, gender, level of participation in mathematics/science education organizations and/or philosophical alignment with and content knowledge of reform issues?

The outcomes anticipated from this study are:

1) A status report about teachers' concerns regarding adoption of the mathematics/science curriculum reform;

2) Research data regarding gender, years of teaching, educational background, level of teaching, level of participation in mathematics education organizations, and philosophical alignment with and content knowledge of curriculum reform issues; and

3) Feedback to curriculum directors regarding appropriate intervention strategies to assist teachers in adopting the reform.

SAMPLE

The purpose of this research project was to conduct a statewide survey to monitor the implementation of mathematics and science curriculum reform at the K-12 (kindergarten to grade 12) grade levels in Iowa. Data were collected by a mail questionnaire from a stratified random sample of secondary mathematics teachers, secondary science teachers, middle school/junior high mathematics teachers, middle school/junior high science teachers, a set of grades K-4 teachers for each of mathematics and science, mathematics teachers who participated in the model classroom project, and science teachers who participated in the model classroom project. The Department of Education provided names and addresses of teachers who taught in Iowa schools during the 1995-96 academic year. The Iowa Mathematics and Science Coalition provided names and addresses of teachers who participated in Iowa's State Systemic Initiative (SSI) project "Modeling Science and Mathematics Reform". Teachers who participated in the modeling classroom project were removed from the Department of Education list prior to a random sample being drawn of mathematics teachers and a sample of science teachers.

A total of 1858 questionnaires were mailed: 1500 teachers were selected from the Department of Education list to participate in either the mathematics group (750) or the science group (750) and 358 teachers from the modeling classroom project received questionnaires for their respective disciplines (179 mathematics, 179 science). Two hundred fifty teachers were chosen from the Department of Education list for each of the grade levels for each discipline: 250 secondary mathematics teachers, 250 middle school/junior high mathematics teachers, 250 elementary teachers (mathematics), 250 secondary science teachers, 250 middle school/junior high science teachers, 250 elementary teachers (science). As indicated in Table 1, the overall return rate was 38.7%.

Table 1. Return Rates for All Groups Surveyed

Group	Sample Size	Number of Respondents	Percent Returned
Mathematics			
Random Sample	750	286	38.1%
Model Classroom	179	82	45.8%
Column Total	929	368	39.6%
Science			
Random Sample	750	239	31.9%
Model Classroom	179	112	62.6%
Science	929	351	37.8%
Total	1858	719	38.7%

SURVEY INSTRUMENTS

The survey instrument consisted of four sections. The Demographic Information section included questions about race, years of teaching experience, number of classes taught in discipline, number of different daily subject preparations, educational background in mathematics/science and/or mathematics/science education, amount of time spent on professional development in past year, and recency of last course or in-service education experience in the discipline or related teaching.

The second section, Professional Activity Participation, gathered information on a participant's level of participation in mathematics or science education organizations. Thirty-one questions for the mathematics questionnaire and twenty-seven for the science questionnaire were written to gather information on two dimensions of participation: type of involvement and level of involvement. Five categories for type of involvement were used: Passive, Leadership 1, Leadership 2, Instructional Advancement, and Outreach. Items in the Passive category included membership, reading journals, conference attendance, and informal discussions about the reform effort. Items in the Leadership 1 category included being a member of a committee or executive board. Leadership 2 included items that refer to being a chairperson of a committee, a member of an evaluation team, and/or a demonstration teacher in the model classroom project. Items in the Instructional Advancement category centered on participation in workshops, graduate courses, national projects, national award programs, and the model classroom project as a visitor. The fifth category, Outreach, included questions regarding conference presentations, articles published, newsletter and/or journal editing, and formal discussions about the reform effort.

The second dimension of participation was the level of involvement for each item. The responses on the mathematics questionnaire were categorized as (1) None, (2) Local Education Area (LEA), (3) Area Educational Area (AEA), (4) state but not the Iowa Council of Teachers of Mathematics (ICTM),(5) ICTM, (6) national but not NCTM, and (7) NCTM. These categories were further reduced for some analysis to Non-ICTM/NCTM and ICTM/NCTM. Due to the large number of state and national organizations and projects, the categorical responses on the science questionnaire were (1) None, (2) LEA, (3) AEA, (4) state, and (5) national.

Information regarding content knowledge of and a philosophical alignment with the current curriculum reform efforts was gathered in the third section using a set of questions in a Philosophy and Content section. This section consisted of 39 items on the mathematics questionnaire and 35 items on the science questionnaire. The items, focused on statements concerning the respective curriculum reform issues presented in documents referring to the standards for each discipline, included the appropriate use of technology, use of alternative teaching and assessment strategies, the role of the discipline in students' overall education, etc.

The fourth section consisted of the 35 item Stages of Concern About the Innovation Questionnaire (SoCQ) (Hall, Wallace, & Dossett, 1973) and a request for a one or two paragraph written response to the question, "When I think about my involvement with the mathematics (science) curriculum reform I am concerned about: __.". A seven response Likert-type scale to ascertain the degree to which the items accurately described the teachers' concerns was used. The original responses of zero to seven were recoded for the computer answer sheet as one to eight where 1 represented 'No Relevance', 3 represented 'Not true of me now', 5 represented ' Somewhat true of me now', and 8 represented 'Very true of me now'.

The SoCQ is used to identity the concerns of key players involved in implementing an innovation (Hall & Hord, 1987). Research using SoCQ supports its use as a valid and reliable means of assessing the degree of implementation of an innovation by assessing the position of individuals faced with an innovation along a continuum of seven sequential stages: Awareness, Information, Personal, Task, Consequence, Collaboration, and Refocusing. This continuum begins with simple awareness and progresses to the development of ideas for tailoring the innovation to their specific needs. Each of the seven stages of concern is comprised of five items on the SoCQ. As illustrated in Figure 1, the seven stages were collapsed into four categories: Awareness/Information, Self(Personal), Task, and Impact (Consequence, Collaboration, and Refocusing).

An individual was placed in the Awareness/Information category if intense Awareness an/or Information concerns were expressed. Intense awareness concerns are concerns unrelated to the innovation as indicated by high end responses to questions such as "I don't even know what the innovation is" , "I am not concerned about this innovation.", "I am completely occupied with other things.". Intense concerns for additional information (Information stage) are indicated by high scores to the items regarding the individual's limited knowledge about the innovation, desire to discuss the possibility of using the innovation, or request for information regarding what resources are available if the innovation is adopted.

Personal concerns relate to how the innovation affects the individual. Indication of these concerns is marked by high-end responses to questions such as, "I would like to know the effect of reorganization on my professional status.", "I would like to know who will make the decisions in the new system.", "I would like to know how my teaching or administration is supposed to change.", "I would like to have more information on time and energy commitments required by this innovation.", and "I would like to know how my role will change when I am using the innovation."

Concerns regarding the individual's use of the innovation (Task category) are indicated by high responses to questions such as, "I am concerned about not having enough time to organize myself each day.", "I am concerned about conflict between my interests and my responsibilities.", "I am concerned about my inability to manage all the innovation requires.", "I am concerned about time spent working with nonacademic problems related to this innovation.", and "Coordination of tasks and people is taking too much of my time."

An individual with intense concerns regrading the impact of the innovation on the students, colleagues, and overall curriculum/administration would express Consequence, Collaboration, and/or Refocusing concerns. Consequence concerns are indicated with high-end scale responses regarding students' attitudes toward the innovation, how the innovation affects students, how to excite students about their part in the innovation, and how to use student feedback to change the program. Individuals with high-end responses to questions pertaining to helping other faculty in their use of the innovation, familiarizing other departments or persons with the progress of the new approach, and coordinating efforts with others to maximize the innovation's effects exhibited intense Collaboration concerns. At the end of the continuum are individuals who are have worked with the program for a long time and are ready to move into a new innovation. These individuals responsed on the high end of the scale to questions regarding knowing other approaches that might work better, modifying the use of the innovation based on experiences of the students, and determining how to supplement, enhance, or replace the innovation.

Identification of concerns of individuals involved in the change process provides useful information for prescribing appropriate interventions that aids progress through the stages without becoming fixated or "stalled" at any point. Figure 1 describes the seven stages and shows the concerns categories used in the 1990 and 1995 studies. Typical expressions of concerns indicative of each stage are in Figure 2. See Appendix A for a copy of the survey instrument.

	Stages of Concern	Expressions of Concern
7	Refocusing	I have some ideas about something that would work even better.
6	Collaboration	I am concerned about relating what I am doing with what other instructors are doing.
5	Consequence	How is my use affecting the students?
4	Task	I seem to be spending all my time in getting material ready.
3	Personal	How will using it affect me?
2	Information	I would like to know more about it.
1	Awareness	I am not concerned about it.

Figure 2. Stages of concern: Typical expressions of concern about the innovation (Adapted by permission from Research and Development Center for Teacher Education, 1983, p.6)

RESULTS

The results, organized to allow discussion of the separate disciplines and yet structured to permit appropriate comparison of the complex analysis of data from two different studies (mathematics teachers and science teaches), are presented in four sections with a discussion of mathematics and science in each section. Description of the participants based upon results from the Stages of Concern Questionnaire are in the first section. The second section contains the results of the Demographic Information. The third section contains the results from the Professional Activity Participation section. Analysis from the Philosophy and Content section are reported in the fourth section. The results from the analysis of Stages of Concern with Demographic, Professional Activity Participation, and Philosophy and Content data are integrated into each respective section.

Stages of Concern

The last section of the survey instrument consisted of the 35 item Stages of Concern About the Innovation Questionnaire (SoCQ) (Hall, Wallace, & Dossett, 1973) and a request for a one or two paragraph written response to the question, "When I think about my involvement with the mathematics (science) curriculum reform I am concerned about: __". The data from the SoCQ were analyzed using a SAS program (George, 1985) to transform raw data into SoC profiles using the process described in the Quick Scoring Device for the Stages of Concern Questionnaire (Parker & Griffin, 1979). Six mathematics and 22 science questionnaires were not included in the results because they were returned without completing the SoC section, with items filled out incorrectly and/or with no discernible pattern of responses from which a profile could be identified. The total number of usable responses was 362 for mathematics and 329 for science.

Interpretations of the profile plots (see Appendix B for example) were made to provide a detailed description of the teachers' concerns. The multiple peak profile analysis procedure (Parker & Griffin, 1979) and the information from the written response were used to identify a primary stage (SoC1), secondary stage (SoC2), and positive or negative attitude (SoCPN) toward the reform effort. A secondary stage could not be identified for 68 mathematics profiles and 106 science profiles which resulted in 294 valid responses for mathematics and 223 valid responses for science with identifiable primary/secondary concerns. Don Horsley of Don Horsley & Associates provided assistance in profile analysis.

The SoC discussion will be presented for mathematics followed by a discussion for science. A comparison of the two disciplines is not relevant except as indicative of the validity of the SoC questionnaire to monitor implementation progress.

Mathematics

A 1990 SoC study regarding the NCTM *Standards* surveyed secondary mathematics teachers who were members of ICTM (Fagan, 1991). The seven stages were collapsed in five categories that are similar to the four categories used in this study. See Figure 1. The results of the 1990 study indicated that 11.8% of the participants were unfamiliar with the issues (Unrelated category) and 65.1% expressed Self-Positive or Self-Negative concerns. A total of 76.9% of the identified concerns were in the first three stages (Awareness, Information, and Personal). By comparison, the secondary teachers in the current study who were identified with Awareness/Information or Self concerns accounted for 28.2% and 32.5%, respectively, of the concerns; a total of 60.7% of the concerns in the first three stages. Additionally, in the 1990 study, 23% of the survey participants were dealing with Task and Impact concerns compared to 39.4% of the secondary teachers in the current survey (Table 2). The progression of secondary teacher concerns indicates movement from early stages to later stages; i.e., resolution of Awareness/Information concerns and heightened arousal of Self, Tasks, and Impact concerns. This progression is characteristic of a satisfactory implementation of an innovation (e.g., mathematics curriculum reform).

Table 2. Mathematics: Comparison of 1990 and 1995 Grade Level SoC1 Data

SoC1	Secondary 1990	Grade Levels Secondary 1995	Middle School	Elementary	N %
Unrelated	50 11.8%[a]	NA	NA	NA	NA
Self-Positive	182 43.1%	NA	NA	NA	NA
Self-Threatened	93 22.0%	NA	NA	NA	NA
Awareness/ Information	NA	33 28.2%[a]	21 17.1%[a]	27 22.1%[a]	81 22.4%[a]
Self	NA	38 32.5%	49 39.8%	36 29.5%	123 34.0%
Tasks	84 19.9%	34 29.1%	30 24.4%	32 26.2%	96 26.5%
Impact	13 3.1%	12 10.3%	23 18.7%	27 22.1%	62 17.1%
Column Totals	422	117	123	122	362

a Column percents

Only primary concerns were considered in the 1990 study. By identifying a secondary concern and the positive/negative inclination, a more detailed analysis of the current implementation status is available. One hundred seventy-one teachers (47.2%) indicated a positive inclination toward the reform effort. Although overall 60.5% teachers expressed primary concerns of Self or Task (Table 3), it is significant that only 83 (22.9%) have a positive attitude toward the reform effort. Self

Table 3. Mathematics: Primary Stages of Concern (SoC1) With Secondary Stages of Concern (SoC2) with Positive/Negative (SoCPN)

		SoC2			N1	No	N2
SoC1	AI[a]	Self	Task	Impact	%	SoC2	%
AI[a]	0 0%[b]	44 59.5%	12 16.2%	18 24.3%	74 91.4%[c]	7 8.6%	81 22.4%
Positive	0 0%	6 24.0%	3 12.0%	16 64.0%	25 89.3%	3 10.7%	28 7.7%
Negative	0 0%	38 77.6%	9 18.4%	2 4.1%	49 92.5%	4 7.5%	53 14.6%
Self	24 25.3%	0 0%	31 32.6%	40 42.1%	95 77.2%	28 22.8%	123 34.0%
Positive	5 12.5%	0 0%	6 15.0%	29 72.5%	40 93.0%	3 7.0%	43 11.9%
Negative	19 34.5%	0 0%	25 45.5%	11 20.0%	55 68.8%	25 31.3%	80 22.1%
Task	18 24.0%%	34 45.3%	0 0%	23 30.7%	75 78.1%	21 21.9%	96 26.5%
Positive	6 17.1%	7 20.0%	0 0%	22 62.9%	35 87.5%	5 12.5%	40 11.0%
Negative	12 30.0%	27 67.5%	0 0%	1 2.5%	40 71.4%	16 28.6%	56 15.5%
Impact	14 28.0%	28 56.0%	8 16.0%	0 0%	50 80.6%	12 19.4%	62 17.1%
Positive	14 28.6%	27 55.1%	8 16.3%	0 0%	49 81.7%	11 18.3%	60 16.6%
Negative	0 0%	1 100%	0 0%	0 0%	1 50.0%	1 50.0%	2 0.6%
Column Total	56 19.0%	106 36.1%	51 17.3%	81 27.6%	294 81.2%	68 18.8%	362 100%
Positive	25 14.6%	40 23.4%	17 9.9%	67 39.2%	149 87.1%	22 12.9%	171 47.2%
Negative	31 16.2%	66 34.6%	34 17.8%	14 7.3%	145 75.9%	46 24.1%	191 52.8%

[a] Awareness/ Information
[b] Row percent based on N1
[c] Row percent based on N2

Table 4. Mathematics: SoC1 with SoC2 and SoCPN

SoC 1	SoC 2				N1 %	SoCPN		N2 %
	AI[a]	Self	Tasks	Impact		Positive	Negative	
AI[a]	0 0%[b]	44 59.5%	12 16.2%	18 24.3%	74 25.2%	28 34.6%[c]	53 65.4%	81 22.4%
Self	24 25.3%	0 0%	31 32.6%	40 42.1%	95 32.3%	43 35.0%	80 65.0%	123 34.0%
Task	18 18.9%	34 35.8%	0 0%	23 24.2%	75 25.5%	40 41.7%	56 58.3%	96 26.5%
Impact	14 28.0%	28 56.0%	8 16.0%	0 0%	50 17.0%	60 96.8%	2 3.2%	62 17.1%
Column Total	56 19.0%	106 36.1%	51 17.3%	81 27.6%	294 81.2%	171 47.2%	191 52.8%	362 100%

Chi-square = 119.43, $p < .001$

Chi-square = 74.89, $p < .001$

a Awareness/Information
b Row percent based on N1
c Row percent based on N2

Table 5. Science: SoC1 with SoC2 and SoCPN; N =329

SoC 1	SoC 2				N1 %	SoCPN		N2 %
	AI[a]	Self	Tasks	Impact		Positive	Negative	
AI[a]	0 0%[b]	42 68.9%	12 19.7%	7 11.5%	61 27.4%	55 61.1%[c]	35 38.9%	90 27.4%
Self	16 20.0%	0 0%	28 35.0%	36 45.0%	80 35.9%	58 54.7%	48 45.3%	106 32.2%
Task	16 24.6%	22 33.8%	0 0%	27 41.5%	65 29.1%	52 49.1%	54 50.9%	106 32.2%
Impact	4 23.5%	10 58.8%	3 17.6%	0 0%	17 7.6%	26 96.3%	1 3.7%	27 8.2%
Column Total	36 16.1%	74 33.2%	43 19.3%	70 31.4%	223 67.8%	191 58.1%	138 41.9%	329 100%

Chi-square = 110.07, $p < .001$

Chi-square = 20.57, $p < .001$

a Awareness/Informational
b Row percent based on N1
c Row percent based on N2

Table 6. Science: Primary Stages of Concern (SoC1) With Secondary Stages of Concern (SoC2) with Positive/Negative (SoCPN)

	SoC2				N1	No	N2
SoC1	AI[a]	Self	Task	Impact	%	SoC2	%
AI[a]	0 0%[b]	42 68.9%	12 19.7%	7 11.5%	61 67.8%[c]	29 32.2%	90 27.4%
Positive	0 0%	23 59.0%	9 23.1%	7 17.9%	39 70.9%	16 29.1%	55 16.7%
Negative	0 0%	19 86.4%	3 13.6%	0 0%	22 62.9%	13 37.1%	35 10.6%
Self	16 20.0%	0 0%	28 35.0%	36 45.0%	80 75.5%	26 24.5%	106 32.2%
Positive	8 16.3%	0 0%	11 22.4%	30 61.2%	49 84.5%	9 15.5%	58 17.6%
Negative	8 25.8%	0 0%	17 54.8%	6 19.4%	31 64.6%	17 35.4%	48 14.6%
Task	16 24.6%	22 33.8%	0 0%	27 41.5%	65 61.3%	41 38.7%	106 32.2%
Positive	12 26.7%	10 22.2%	0 0%	23 51.1%	45 86.5%	7 13.5%	52 15.8%
Negative	4 20.0%	12 60.0%	0 0%	4 20.0%	20 37.0%	34 63.0%	54 16.4%
Impact	4 23.5%	10 58.8%	3 17.6%	0 0%	17 63.0%	10 37.0%	27 8.2%
Positive	4 23.5%	10 58.8%	3 17.6%	0 0%	17 65.4%	9 34.6%	26 7.9%
Negative	0 0%	0 0%	0 0%	0 0%	0 0%	1 100%	1 0.3%
Column Total	36 16.1%	74 33.2%	43 19.3%	70 31.4%	223 67.8%	106 32.2%	329 100%
Positive	24 16.0%	43 28.7%	23 15.3%	60 40.0%	150 78.5%	41 21.5%	191 58.1%
Negative	12 16.4%	31 42.5%	20 27.4%	10 13.7%	73 52.9%	65 47.1%	138 41.9%

a Awareness/ Information
b Row percents based on N1
c. Row percents based on N2

concerns account for 68.4% of all SoC1/SoC2 combinations; Self and Task concerns account for 89.1% ($x^2 = 119.43$, $p < .001$) (Table 4). The frequent occurrence of negative attitudes (52.2%) associated with all but Impact concerns is disconcerting ($x^2 = 74.89$, $p < .001$) (Table 4).

Science

The science curriculum reform effort is still in the beginning year. This is an initial study to gather baseline information. As shown in Tables 5 and 6, 91.8% teachers expressed primary concerns of Awareness/Information, Self , or Tasks and 58.1% have a positive attitude toward the reform. The primary/secondary concerns are combinations of Awareness/Information, Self, and Task concerns. As in the mathematics data, a large percentage of teachers (64.4%) expressed primary concerns of Self or Task (Table 6); in contrast, though, a majority of the teachers expressed a positive attitude (58.1%). Self concerns account for 69.1% of all SoC1/SoC2 combinations ; Self and Task account for 95.1% ($x^2 = 110.07$, $p < .001$). An encouraging note is the greater percentage of positive attitudes (58.1%) than negative (41.9%) toward the reform effort ($x^2 = 20.57$, $p < .001$).

Demographic

The demographic variables discussed in this section include gender, grade level, model classroom participation, number of years of teaching experience, number of classes taught daily, and number of daily preparations. Data are reported only for the teachers who are included in the Stages of Concern study.

Responses from mathematics and science teachers who reported gender, grade level, or race were similar: more females than males (mathematics: 66%; science: 58.2%), approximately one-third of the returned questionnaires were from each of the grade levels (secondary, middle school/junior high, and elementary teachers), and few non-white respondents. The 82 (45.8%) (Table 1) responses received from mathematics teachers who participated in the model classroom project represented almost one-fourth of the mathematics group (22.3%). The return rate of science

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teachers who participated in the model classroom project was 62.6%; this represented 34% of the total science group. See Table 7.

Table 7. Demographic Information Results: Gender, Race, Grade Level Taught, Model Classroom Participation

Variable	Mathematics		Science	
Gender				
Female	173	18.0%	142	43.2%
Male	89	24.6%	102	31.0%
Missing	100	27.6%	85	25.8%
Column Total	362	100%	329	100%
Race				
White	352	97.2%	316	96.0%
Non-white	9	2.5%	12	3.6%
No Response	1	0.3%	1	0.3%
Column Total	362	100%	329	100%
Grade Level Taught				
Secondary	117	32.3%	110	33.4%
Middle School	123	34.0%	104	31.6%
Elementary	122	34.0%	115	35.0%
Column Total	362	100%	329	100%
Model Classroom Participation				
Visitor	37	10.2%	54	16.4%
Demo Teacher	39	10.8%	43	13.1%
Both	6	1.7%	15	4.6%
None	280	77.3%	217	65.9%
Column Total	362	100%	329	100%

More than half of the teachers reported sixteen or more years teaching experience for both mathematics and science, 62.1% and 56.5% respectively. Of the teachers reporting on this question, 55.6% of the mathematics secondary teachers and 43.6% of the science teachers have more than 20 years of experience. Mathematics teachers who have five or less years of experience are more likely to express Awareness/Information or Self concerns; Self or Tasks concerns are more likely to be expressed by teachers who have taught more than six years ($x^2 = 27.60$, $p < .05$). No similar patterns were observed for the science teachers. See Tables 8 and 10.

The greatest percentage of the teachers who reported teaching one class per day were elementary teachers (mathematics: 78.5%; science: 77.7%). However, the elementary teachers also reported making 5 or more preparations per day (mathematics: 84.4%; science: 81.7%). In comparison, the secondary and middle school teachers reported teaching five to six classes per day and making less than five preparations per day. See Table 8.

The reported professional preparation of secondary teachers for mathematics and science is more extensive than for elementary teachers. As expected, due to the need for a broader curriculum in the elementary program, there is a considerable disparity in the number of earned degrees in the discipline or related education major/minor of elementary teachers and secondary teachers. Secondary teachers reported in greater number earning one or both degrees (mathematics: 93.1%; science: 99.1%) than elementary teachers (mathematics: 6.6%; science: 15.7%). See Table 9.

The lack of mathematics and science preparedness for elementary teachers is continued for reported number of professional development hours and recency of educational experience. A great proportion of elementary teachers reported taking less than six hours (or none) of professional development activities (mathematics: 32.8%; science: 52.2%) and many reported that the activities were a year or more ago (mathematics: 32.8%; science: 39.2%). Mathematics teachers who reported fifteen or less hours of professional development hours are more likely to have a negative attitude toward the reform and those with more than 35 hours are more likely to have a positive attitude ($x^2 = 19.46, p < .001$). See Table 10. Science teachers who have taken less than six hours (or none) of professional development hours are more likely to express Awareness/Information concerns while those who have more than 35 hours are more likely to express Self or Tasks concerns ($x^2 = 35.85, p < .001$). See Table 11.

Professional Activity Participation

The National Council of Teachers of Mathematics (NCTM) and the National Science Teachers Association (NSTA) have led the mathematics and science curriculum reform efforts, respectively. Plans for statewide implementation have been developed and implemented through collaborative efforts of local school districts and Area Education Agencies as well as activities initiated by state organizations such as the Iowa Council of Teachers of Mathematics (ICTM), the Iowa Mathematics and

Table 8. Teaching Assignment Information: Teaching Experience, Number of Classes Taught, Number of Daily Preparations

	Mathematics			Science		
Variable	N	%	N of valid responses	N	%	N of valid responses
Teaching Experience Years			362			329
Less than 3 years	22	6.1%		25	7.6%	
Secondary	7	6.0%	117	8	7.3%	110
Middle School	11	8.9%	123	8	7.7%	104
Elementary	4	3.3%	122	9	7.8%	115
3-5 years	24	6.6%		26	7.9%	
Secondary	4	3.4%	117	7	6.4%	110
Middle School	10	8.1%	123	11	10.6%	104
Elementary	10	8.2%	122	8	7.0%	115
6-10 years	40	11.0%		50	15.2%	
Secondary	13	11.1%	117	14	12.7%	110
Middle School	13	10.6%	123	13	12.5%	104
Elementary	14	11.5%	122	23	20.0%	115
11-15 years	51	14.1%		42	12.8%	
Secondary	13	11.1%	117	14	12.7%	110
Middle School	24	19.5%	123	15	14.4%	104
Elementary	14	11.5%	122	13	11.3%	115
16-20 years	70	19.3%		50	15.2%	
Secondary	15	12.8%	117	19	17.3%	110
Middle School	26	21.1%	123	13	12.5%	104
Elementary	29	23.8%	122	18	15.7%	115
More than 20 years	155	42.8%		136	41.3%	
Secondary	65	55.6%	117	48	43.6%	110
Middle School	39	31.7%	123	44	42.3%	104
Elementary	51	41.8%	122	44	38.3%	115
N of Classes Taught Daily			360			325
1 class	114	31.7%		94	28.9%	
Secondary	5	4.3%	117	3	2.7%	110
Middle School	14	11.5%	122	4	3.9%	103
Elementary	95	78.5%	121	87	77.7%	112
2-4 classes	87	24.2%		66	20.3%	
Secondary	24	20.5%	117	12	10.9%	110
Middle School	43	35.2%	122	31	30.1%	103
Elementary	20	16.5%	121	23	20.5%	112
More than 5 classes	159	44.2%		165	50.8%	
Secondary	88	75.2%	117	95	86.4%	110
Middle School	65	53.3%	122	68	66.0%	103
Elementary	6	5.0%	121	2	1.8%	112
N of Daily Preparations			362			327
1 -4	206	56.9%		213	65.1%	
Secondary	86	73.5%	117	102	93.6%	109
Middle School	101	82.1%	122	90	87.4%	103
Elementary	19	15.6%	123	21	18.3%	115
More than 5	158	43.6%		114	34.9%	
Secondary	31	26.5%	117	7	6.4%	109
Middle School	22	17.9%	123	13	12.6%	103
Elementary	103	84.4%	122	94	81.7%	115

Table 9. Teacher Characteristics: Educational Background, Professional Development Hours, Recency of Educational Experience

	Mathematics			Science		
Variable	N	%	N of valid responses	N	%	N of valid responses
Postsecondary Major/Minor			362			329
Discipline	58	16.0%		56	17.0%	
Secondary	37	31.6%	117	36	32.7%	110
Middle School	18	14.6%	123	16	15.4%	104
Elementary	3	2.5%	122	4	3.5%	115
Education	24	6.6%		22	6.7%	
Secondary	8	6.8%	117	4	3.6%	110
Middle School	14	11.4%	123	10	9.6%	104
Elementary	2	1.6%	122	8	7.0%	115
Both	109	30.1%		116	35.3%	
Secondary	64	54.7%	117	68	61.8%	110
Middle School	42	34.1%	123	42	40.4%	104
Elementary	3	2.5%	122	6	5.2%	115
Neither	171	47.2%		135	41.0%	
Secondary	8	6.8%	117	2	1.8%	110
Middle School	49	39.8%	123	36	34.6%	104
Elementary	114	93.4%	122	97	84.3%	115
Professional. Development Hours			362			329
None	40	11.0%		41	12.5%	
Secondary	8	6.8%	117	6	5.5%	110
Middle School	13	10.6%	123	5	4.8%	104
Elementary	19	15.6%	122	30	26.1%	115
Less than 6 hours	60	16.6%		63	19.1%	
Secondary	18	15.4%	117	18	16.4%	110
Middle School	21	17.1%	123	14	13.5%	104
Elementary	21	17.2%	122	30	26.1%	115
6-15 hours	102	28.2%		71	21.6%	
Secondary	33	28.2%	117	26	23.6%	110
Middle School	34	27.6%	123	23	22.1%	104
Elementary	35	28.7%	122	22	19.1%	115
16-35 hours	69	19.1%		53	16.1%	
Secondary	24	20.5%	117	17	15.5%	110
Middle School	28	22.8%	123	24	23.1%	104
Elementary	17	13.9%	122	12	10.4%	115
More than 35	91	25.1%		102	31.0%	
Secondary	34	29.1%	117	43	38.2%	110
Middle School	27	22.0%	123	38	36.5%	104
Elementary	30	24.6%	122	21	18.3%	115
Recency of Educational Experience			362			329
Within 3 mos	125	34.5%		122	37.1%	
Secondary	41	35.0%	117	45	41.3%	109
Middle School	41	33.3%	123	50	48.1%	104
Elementary	43	35.2%	122	27	23.5%	115
3-6 mos	61	16.9%		49	14.9%	
Secondary	20	17.1%	117	20	18.3%	109
Middle School	24	19.5%	123	12	11.5%	104
Elementary	17	13.9%	122	17	14.8%	115
7-12 mos	69	19.1%		65	19.8%	
Secondary	20	17.1%	117	21	19.3%	109
Middle School	27	22.0%	123	18	17.3%	104
Elementary	22	18.0%	122	26	22.6%	115
1-3 yrs	77	21.3%		62	18.8%	
Secondary	27	23.1%	117	15	13.8%	109
Middle School	23	18.7%	123	20	19.2%	104
Elementary	27	22.1%	122	27	23.5%	115
More than 3 yrs	30	8.3%		30	9.1%	
Secondary	9	7.7%	117	8	7.3%	109
Middle School	8	6.5%	123	4	3.8%	104
Elementary	13	10.7%	122	18	15.7%	115

Table 10. Mathematics: SoC1 and SoCPN with Demographic Variables, N=362

	SoC 1				N %	SoCPN		N %
Variables	AI[a]	Self	Tasks	Impact		Positive	Negative	
Years Experience								
Less than 3 years	6	6	3	7	22			
	27.3%	27.3%	13.6%	31.8%	6.1%			
3-5 Years	7	10	1	6	24			
	29.2%	41.7%	4.2%	25%	6.6%			
6-10 Years	11	11	9	9	40			
	27.5%	27.5%	22.5%	22.5%	11.0%			
11-15 Years	8	18	21	4	51			
	15.7%	35.3%	41.2%	7.8%	14.1%			
16-20 Years	13	29	13	15	70			
	18.6%	41.4%	18.6%	21.4%	19.3%			
More than 20 Years	36	49	49	21	155			
	23.2%	31.6%	31.6%	13.5%	42.8%			
Column Total	81	123	96	62	362			
	22.4%	34.0%	26.5%	17.1%	100%			
Chi-square = 27.60,	p < .05							
Professional Development Hours								
None	16	10	11	3	40	20	20	40
	40.0%	25.0%	27.5%	7.5%	11.0%	50.0%	50.0%	11.0%
Less than 6 hours	15	16	22	7	60	15	45	60
	25.0%	26.7%	36.7%	11.7%	16.6%	25.0%	75.0%	16.6%
6-15 hours	23	36	28	15	102	45	57	102
	22.5%	35.3%	27.5%	14.7%	28.2%	44.1%	55.9%	28.2%
16-35 hours	14	27	13	15	69	36	33	69
	20.3%	39.1%	18.8%	21.7%	19.1%	52.2%	47.8%	19.1%
More than 35 hours	13	34	22	22	91	55	36	91
	14.3%	37.4%	24.2%	24.2%	25.1%	60.4%	39.6%	25.1%
Column Total	81	123	96	62	362	171	191	362
	22.4%	34.0%	26.5%	17.1%	100%	47.2%	52.8%	100%

Chi-square = 22.48, p < .05 Chi-square = 19.46, p < .001

[a] Awareness/Informational

Table 11. Science: SoC1 and SoCPN with Demographic Variables; N=329

Variables	SoC 1				N %
	AI[a]	Self	Tasks	Impact	
Professional Development Hours					
None	20 48.8%	9 22.0%	10 24.4%	2 4.9%	41 12.5%
Less than 6 hours	23 37.1%	22 35.5%	16 25.8%	1 1.6%	62 18.8%
6-15 hours	19 26.8%	21 29.6%	28 39.4%	3 4.2%	71 21.6%
16-35 hours	14 26.4%	20 37.7%	15 28.3%	4 7.5%	53 16.1%
More than 35 hours	14 13.7%	34 33.3%	37 36.3%	17 16.7%	102 31%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%
Chi-square = 35.85,	p <.001				
Recency Educational Experience					
Within 3 mos	25 20.5%	38 31.1%	46 37.7%	13 10.7%	122 37.2%
3-6 mos	18 36.7%	16 32.7%	13 26.5%	2 4.1%	49 14.9%
7-12 mos	17 26.2%	25 38.5%	17 26.2%	6 9.2%	65 19.8%
1-3 years	14 22.6%	19 30.6%	24 38.7%	5 8.1%	62 18.9%
More than 3 years	16 53.3%	8 28.7%	5 16.7%	1 3.3%	30 9.1%
Column Total	90 27.4%	106 32.3%	105 32.0%	27 8.2%	328 100%

Chi-square = 21.07, $p < .05$

[a] Awareness/Informational

Science Coalition (IMSC), the Iowa Science Teachers Section of the Iowa Academy of Science, and others. Organizational activities that serve to inform members of current curriculum reform issues permit members to participate at various levels. An accurate description of a teacher's participation in discipline-related professional activities includes both components: the level of participation and the type of participation. Participation in these activities in turn affects the status of implementation.

The questions in the Professional Activity Participation section gathered information on a teacher's level of participation in mathematics or science education organizations on two dimensions: type of participation and level of participation. The type of participation includes activities in which a member could participate, such as organization membership, conferences, journals, workshops, and elected offices. Other participation opportunities that are available outside of professional organizations include curriculum development projects, graduate classes, model classrooms, and award programs.

The activities were grouped into five categories identified for type of participation in a professional education organization: Passive, Leadership 1 (Committee Member), Leadership 2 (Committee Chair), Instructional Advancement, and Outreach. Activities in the Passive category include membership, reading journals, conference attendance, and informal discussions about the reform effort. Leadership 1 (Committee Member) and Leadership 2 (Committee Chair) categories include member and chair roles, respectively, of committee and executive board activities. Also included in Leadership 2 are activities related to evaluation teams and demonstration teachers in the demonstration classroom project. Instructional Advancement activities center on participation in workshops, graduate courses, national projects, national award programs, and the visitor teachers in the demonstration classroom project. The fifth category, Outreach, includes activities regarding conference presentations, articles contributed and/or published, newsletter and/or journal editor and formal discussions about the reform effort. See the Appendix A for a copy of the questions.

Mathematics

A professional organization may be a local district group, a regional group such as an Area Educational Agency, a state organization such as the Iowa Council of Teachers of Mathematics (ICTM), or a national organization such as the National Council of Teachers of Mathematics (NCTM). The ICTM is the only state organization that serves as an affiliated group of the national organization, NCTM. Although other state and national initiatives have been instrumental in promoting mathematics curriculum reform, participation in ICTM and/or NCTM activities are of great interest with regards to implementation status. The eight categories used for the level of participation to reflect this are:

(1) No participation,

(2) Participation in local and/or area activities within the state,

(3) Participation in state activities not including ICTM activities,

(4) Participation in ICTM activities,

(5) Participation in national activities but not in ICTM or NCTM,

(6) Participation in national activities and ICTM but not NCTM,

(7) Participation in national activities and NCTM but not ICTM,

(8) Participation in ICTM and NCTM.

The last seven categories were further reduced to two categories for crosstabulation analysis of data:

(9) Participation in at least one activity except ICTM or NCTM,

(10) Participation in ICTM or NCTM.

Passive Passive activities are defined as those which require minimal time and effort on the part of the teacher. Activities such as organization membership, reading journals, and attending conferences are important in professional development and in gathering information regarding current curriculum issues but demand minimal additional teacher time and commitment.

Participation in ICTM and/or NCTM activities of membership, reading journals, and attending conferences was reported by more than half of the teachers with the majority being secondary and middle school/junior high teachers. Of the 197 (54.4%) teachers who reported membership in ICTM and/or NCTM, 77 were secondary teachers and 76 were middle school/junior high teachers. Teachers who reported no memberships more often expressed Awareness/Information or Self Concerns ($x^2 = 19.24$, $p < .01$) and were more likely to have negative attitudes toward the reform effort ($x^2 = 14.92$, $p < .001$). In contrast, teachers who reported membership in ICTM and/or NCTM expressed Self or Task Concerns and a positive attitude. See Tables 12 and 13.

More than 65% of the secondary and middle school/junior high teachers reported reading ICTM and/or NCTM journals and attending conferences of the organizations. As with membership, reading journals and attending conferences have a significant relationship with the concerns and attitude toward reform. Teachers who reported reading journals and attending conferences of the ICTM and/or NCTM expressed Self or Task concerns ($x^2 = 26.48$, $p < .001$ and $x^2 = 12.83$, $p < .05$, respectively) and a positive attitude ($x^2 = 9.46$, $p < .01$ and $x^2 = 15.22$, $p < .001$, respectively). Awareness/Information or Self concerns and a negative attitude were expressed by teachers who did not participate in the organizations' activities. See Tables 12 and 13.

Informal discussions about the reform effort occurred more often between teachers and administrators (62.7%), family and friends (58.3%), and parents (56.6%). Categories for colleagues, school boards, and graduate courses were omitted on the questionnaire. Discussions with these groups were included in the counts for parents, family and friends, or other category. See Table 12.

Leadership 1 (Committee Member) One characteristic of leadership and professional competence is a willingness to serve on committees. Teachers who accept committee work are willing to commit time and energy beyond their required teaching duties to a project or an organization. These commitments include membership of an organization committee, conference planning committee, a curriculum development committee, or an executive board. Also included in this category is membership in the national award program, Council of Presidential Awardees in Mathematics (CPAM).

No teachers reported serving as a member on an ICTM and/or NCTM committee, conference planning committee, or curriculum development committee. Local and/or area level participation was reported by 42.8% of the teachers in committee membership, 16.6% of the teachers in conference planning, and 69.9% of the teachers in curriculum development. Teachers who reported serving as a member and/or working on a curriculum development committee at this level were more likely to express Self, Task, or Impact concerns compared to the Awareness/Information, Self, or Task concerns of teachers who have not participated ($x^2 = 11.63$, $p < .01$ and $x^2 = 12.68$, $p < .01$, respectively). Positive attitudes were more frequently identified for teachers who have worked on curriculum development than those who have not ($x^2 = 13.58$, $p < .001$). Few teachers (8.8%) reported participation in CPAM activities but those who did were more likely to express a positive attitude ($x^2 = 20.47$, $p < .001$). See Tables 14 and 15.

Leadership 2 (Committee Chair) The Leadership 2 category extends the commitment described in Leadership 1 to include serving as chair of a committee and providing assistance and guidance to other teachers. These commitments include serving as chair of an organization committee, of a conference planning committee, or of a curriculum development committee. Also included in this category is membership on a North Central Evaluation (NCE) team and serving as a demonstration teacher in the demonstration classroom program.

No teachers reported serving as a chair for any ICTM and/or NCTM committee, conference planning, or curriculum development. Local and/or area level participation was reported by 18% of the teachers for committee chair, 5.5% for conference planning committee chair, and 25.1% in curriculum development committee chair. Teachers who have not served as a chair for a curriculum development committee expressed more Awareness/Information or Self concerns; Self and Tasks concerns were expressed more frequently by teachers who have chaired local, area, non-ICTM, or non-NCTM curriculum development committees ($x^2 = 13.44$, $p < .01$). Few teachers (4.4%) reported participation on a NCE team. Forty-five (12.5%) teachers have served as a demonstration teacher in the model classroom project. The demonstration teachers were more likely to express Task or Impact concerns

Table 12. Mathematics: Passive Participation Frequencies in Professional Organizations; N=362 (Secondary = 117, Middle School =123, Elementary = 122)

	Level of Participation[a]									
	Original Categories								Collapsed Categories	
Variables	None	2	3	4	5	6	7	8	9	10
9. Membership	164	0	0	59	1	2	22	114	1	197
	45.3%	0%	0%	16.3%	0.3%	0.6%	6.1%	31.5%	0.3%	54.4%
% of Secondary	34.2%	0%	0%	15.4%	0%	0%	7.7%	42.7%	0%	65.8%
% of Middle School	37.4%	0%	0%	17.1%	0.8%	0.8%	8.1%	35.8%	0.8%	61.8%
%of Elementary	63.9%	0%	0%	16.4%	0%	0.8%	2.5%	16.4%	0%	36.1%
10. Read Journals	138	0	0	31	4	2	81	106	4	220
	38.1%	0%	0%	8.6%	1.1%	0.6%	22.4%	29.3%	1.1%	60.8%
% of Secondary	31.6%	0%	0%	11.1%	0%	0%	17.1%	40.2%	0%	68.4%
% of Middle School	32.5%	0%	0%	8.1%	2.4%	0%	26.0%	30.9%	2.4%	65.0%
%of Elementary	50.0%	0%	0%	6.6%	0.8%	1.6%	23.8%	17.2%	0.8%	49.2%
11.Attend	143	6	6	123	0	2	18	64	12	207
Conferences	39.5%	1.7%	1.7%	34.0%	0%	0.6%	5.0%	17.7%	3.3%	57.2%
% of Secondary	26.5%	0.9%	0.9%	37.6%	0%	0.9%	5.1%	28.2%	1.7%	71.8%
% of Middle School	35.8%	0%	1.6%	36.6%	0%	0.8%	7.3%	17.9%	1.6%	62.6%
%of Elementary	55.7%	4.1%	2.5%	27.9%	0%	0%	2.5%	7.4%	6.6%	37.7%

	None	Parents	Business	Legislative Rep	Students	Administrators	Family/ Friends	Other
17. Discuss Informally[b]	12.7%	56.6%	14.4%	3.6%	48.3%	62.7%	58.3%	11.9%

a Participation in lower levels is assumed in higher levels. Percentages of the first 8 categories add to 100; percentages of the last two categories add to 100. See page 22 for explanation of code.

b Percentages do not add to 100; some respondents gave multiple responses.

Table 13. Mathematics: SoC1 and SoCPN with Passive Participation Variable; N=362

		SoC 1			N %	SoCPN		N %
Variables	AI[a]	Self	Tasks	Impact		Positive	Negative	
9. Membership								
None	49 29.9%	51 31.1%	46 28.0%	18 11.0%	164 45.3%	60 36.6%	104 63.4%	164 45.3%
not ICTM,not NCTM	1 100%	0 0%	0 0%	0 0%	1 0.3%	0 0%	1 100%	1 0.3%
ICTM, NCTM	31 15.7%	72 36.5%	50 25.4%	44 22.3%	197 54.4%	111 56.3%	86 43.7%	197 54.4%
Column Total	81 22.4%	123 34.0%	96 26.5%	62 17.1%	362 100%	171 47.2%	191 52.8%	362 100%
Chi-square = 19.24,	p < .01					Chi-square = 14.92, p < .001		
10. Reading Journals								
None	45 32.6%	38 27.5%	42 30.4%	13 9.4%	138 38.1%	52 37.7%	86 62.3%	138 38.1%
not ICTM,not NCTM	2 50%	2 50%	0 0%	0 0%	4 1.1%	1 25%	3 75%	4 1.1%
ICTM, NCTM	34 15.5%	83 37.7%	54 24.5%	49 22.3%	220 60.8%	118 53.6%	102 46.4%	220 60.8%
Column Total	81 22.4%	123 34.0%	96 26.5%	62 17.1%	362 100%	171 47.2%	191 52.8%	362 100%
Chi-square = 26.48,	p < .001					Chi-square = 9.46, p < .01		
11. Attend Conferences								
None	43 30.1%	47 32.9%	38 26.6%	15 10.5%	143 39.5%	50 35.0%	93 65.0%	143 39.5%
not ICTM,not NCTM	2 16.7%	4 33.3%	4 33.3%	2 16.7%	12 3.3%	5 41.7%	7 58.3%	12 3.3%
ICTM, NCTM	36 17.4%	72 34.8%	54 26.1%	45 21.7%	207 57.2%	116 56.0%	91 44.0%	207 57.2%
Column Total	81 22.4%	123 34.0%	96 26.5%	62 17.1%	362 100%	171 47.2%	191 52.8%	362 100%
Chi-square = 12.83,	p < .05					Chi-square = 15.22, p < .001		

[a] Awareness/Informational

Table 14. Mathematics: Leadership 1 (Committee Member) Participation Frequencies in Professional Organizations; N=362 (Secondary = 117, Middle School =123, Elementary = 122)

	Level of Participation[a]									
	Original Categories								Collapsed Categories	
Variables	None	2	3	4	5	6	7	8	9	10
15. Organization	202	155	2	0	3	0	0	0	160	0
Committee	55.8%	42.8%	0.6%	0%	0.8%	0%	0%	0%	44.2%	0%
% of Secondary	48.7%	50.4%	0%	0%	0.9%	0%	0%	0%	51.3%	0%
% of Middle School	52.0%	46.3%	0.8%	0%	0.8%	0%	0%	0%	48.0%	0%
% of Elementary	66.4%	32.0%	0.8%	0%	0.8%	0%	0%	0%	33.6%	0%
21. Conference	296	60	2	0	4	0	0	0	66	0
Planning	81.8%	16.6%	0.6%	0%	1.1%	0%	0%	0%	18.2%	0%
% of Secondary	78.6%	19.7%	0%	0%	1.7%	0%	0%	0%	21.4%	0%
% of Middle School	82.9%	16.3%	0.8%	0%	0%	0%	0%	0%	17.1%	0%
% of Elementary	83.6%	13.9%	0.8%	0%	1.6%	0%	0%	0%	16.4%	0%
23. Curriculum	108	253	0	0	1	0	0	0	254	0
Development	29.8%	69.9%	0%	0%	0.3%	0%	0%	0%	70.2%	0%
% of Secondary	22.2%	77.8%	0%	0%	0%	0%	0%	0%	77.8%	0%
% of Middle School	26.0%	73.2%	0%	0%	0.8%	0%	0%	0%	74.0%	0%
% of Elementary	41.0%	59.0%	0%	0%	0%	0%	0%	0%	59.0%	0%
25. Executive Board	348	0	1	12	0	0	1	0	1	13
	96.1%	0%	0.3%	3.3%	0%	0%	0.3%	0%	0.3%	3.6%
% of Secondary	98.3%	0%	0%	1.7%	0%	0%	0%	0%	0%	1.7%
% of Middle School	95.1%	0%	0%	4.1%	0%	0%	0.8%	0%	0%	4.9%
% of Elementary	95.1%	0%	0.8%	4.1%	0%	0%	0%	0%	0.8%	4.1%

	No	No but Applied	State Awardee	State Finalist
31. CPAM[b]	330	24	5	3
	91.2%	6.6%	1.4%	0.8%

[a] Participation in lower levels is assumed in higher levels. Percentages of the first 8 categories add to 100; percentages of the last two categories add to 100. See page 22 for explanation of code.

[b] Council of Presidential Awardees for Mathematics

Table 15. Mathematics: SoC1 and SoCPN with Leadership 1 (Committee Member) Participation Variable; N=362

	SoC 1				N %	SoCPN		N %
Variables	AI[a]	Self	Tasks	Impact		Positive	Negative	
15. Organization								
None	56 27.7%	64 31.7%	56 27.7%	26 12.9%	202 55.8%			
not ICTM,not NCTM	25 15.6%	59 36.9%	40 25.0%	36 22.5%	160 44.2%			
ICTM, NCTM	0 0%	0 0%	0 0%	0 0%	0 0%			
Column Total	81 22.4%	123 34.0%	96 26.5%	62 17.1%	362 100%			
Chi-square = 11.63, p < .01								
23. Curriculum Development								
None	34 31.5%	37 34.3%	28 25.9%	9 8.3%	108 29.8%	35 32.4%	73 67.6%	108 29.8%
not ICTM,not NCTM	47 18.5%	86 33.9%	68 26.8%	53 20.9%	254 70.2%	136 53.5%	118 46.5%	254 70.2%
ICTM, NCTM	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Column Total	81 22.4%	123 34.0%	96 26.5%	62 17.1%	362 100%	171 47.2%	191 52.8%	362 100%
Chi-square = 12.68, p < .01						Chi-square = 13.58, p < .001		
25. Executive Board								
None						160 46.0%	188 54.0%	348 96.1%
not ICTM,not NCTM						0 0%	1 100%	1 0.3%
ICTM, NCTM						11 84.6%	2 15.4%	13 3.6%
Column Total						171 47.2%	191 52.8%	392 100%
						Chi-square = 8.40, p < .05		
31. CPAM[b]								
No	79 23.9%	111 33.6%	90 27.3%	50 15.2%	330 91.2%	144 43.6%	186 56.4%	330 91.2%
No, but applied	2 8.3%	10 41.7%	5 20.8%	7 29.2%	24 6.6%	19 79.2%	5 20.8%	24 6.6%
State Awardee	0 0%	2 40.0%	1 20.0%	2 40.0%	5 1.4%	5 100%	0 0%	5 1.4%
State Finalist	0 0%	0 0%	0 0%	3 100%	3 0.8%	3 100%	0 0%	3 0.8%
Column Total	81 22.4%	123 34.0%	96 26.5%	62 17.1%	362 100%	171 47.2%	191 52.8%	392 100%
Chi-square = 23.35, p < .01						Chi-square = 20.47, p < .001		

a Awareness/Informational

b Council of Presidential Awardees in Mathematics

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Table 16. Mathematics: Leadership 2 (Committee Chair) Participation Frequencies in Professional OrganizationsN=362 (Secondary = 117, Middle School =123, Elementary = 122)

	Level of Participation[a]									
	Original Categories								Collapsed Categories	
Variables	None	2	3	4	5	6	7	8	9	10
16. Organization	295	65	1	0	1	0	0	0	67	0
Committee	81.5%	18.0%	0.3%	0%	0.3%	0%	0%	0%	18.5%	0%
%of Secondary	68.4%	31.6%	0%	0%	0%	0%	0%	0%	31.6%	0%
%of Middle School	82.1%	16.3%	0.8%	0%	0.8%	0%	0%	0%	17.9%	0%
% of Elementary	93.4%	6.6%	0%	0%	0%	0%	0%	0%	6.6%	0%
22. Conference	337	20	2	0	3	0	0	0	25	0
Planning	93.1%	5.5%	0.6%	0%	0.8%	0%	0%	0%	6.9%	0%
%of Secondary	92.3%	7.7%	0%	0%	0%	0%	0%	0%	7.7%	0%
%of Middle School	91.9%	4.1%	1.6%	0%	2.4%	0%	0%	0%	8.1%	0%
% of Elementary	95.1%	4.9%	0%	0%	0%	0%	0%	0%	4.9%	0%
24. Curriculum	269	91	0	0	2	0	0	0	93	0
Development	74.3%	25.1%	0%	0%	0.6%	0%	0%	0%	25.7%	0%
%of Secondary	64.1%	35.9%	0%	0%	0%	0%	0%	0%	35.9%	0%
%of Middle School	75.6%	23.6%	0%	0%	0.8%	0%	0%	0%	24.4%	0%
% of Elementary	82.8%	16.4%	0%	0%	0.8%	0%	0%	0%	17.2%	0%

	No	Yes
29. North Central	345	16
Evaluation Team	95.6%	4.4%

	Teacher	Visitor and teacher
30. Model Classroom	39	6
Teacher[b]	10.8%	1.7%

a Participation in lower levels is assumed in higher levels. Percentages of the first 8 categories add to 100; percentages of the last two categories add to 100. See page 22 for explanation of code.

b Percentages do not add to 100; some respondents gave responses that are presented in Table 18 under Model Classroom Visitor.

Table 17. Mathematics: SoC1 and SoCPN with Leadership 2 (Committee Chair) Participation Variable; N=36

	SoC 1				N %	SoCPN		N %
Variables	AI[a]	Self	Tasks	Impact		Positive	Negative	
24. Curriculum Development								
None	71	93	66	39	269			
	26.4%	34.6%	24.5%	14.5%	74.3%			
not ICTM,not NCTM	10	30	30	23	93			
	10.8%	32.3%	32.3%	24.7%	25.7%			
ICTM, NCTM	0	0	0	0	0			
	0%	0%	0%	0%	0%			
Column Total	81	123	96	62	362			
	22.4%	34.0%	26.5%	17.1%	100%			
Chi-square = 13.44,	p < .01							
30. Model Classroom								
No	71	95	80	34	280	122	158	280
	25.4%	33.9%	28.6%	12.1%	77.3%	43.6%	56.4%	77.3%
Visitor	7	14	10	6	37	17	20	37
	18.9%	37.8%	27.0%	16.2%	10.2%	45.9%	54.1%	10.2%
Teacher	1	13	6	19	39	28	11	39
	2.6%	33.3%	15.4%	48.7%	10.8%	71.8%	28.2%	10.8%
Visitor and Teacher	2	1	0	3	6	4	2	6
	33.3%	16.7%	0%	50%	1.7%	66.7%	33.3%	1.7%
Column Total	81	123	96	62	362	171	191	392
	22.4%	34.0%	26.5%	17.1%	100%	47.2%	52.8%	100%

Chi-square = 43.62, p < .001

Chi-square = 11.88, p < .01

[a] Awareness/Informational

and a positive attitude toward the reform ($x^2 = 43.62$, $p < .01$ and $x^2 = 11.88$, $p < .01$, respectively). See Tables 16 and 17.

Instructional Advancement Instructional Advancement activities develop and strengthen a teacher's professional and academic preparation for teaching mathematics particularly in current curriculum reform issues. Workshops, graduate courses, national projects, national award programs, and the visiting teacher role in the demonstration classroom project are included in this category.

No teachers reported participating in any ICTM and/or NCTM workshops although a substantial number (71.5%) participated in local and/or area activities. More than half (52.2%) of the teachers have enrolled in at least one graduate level course. However, consistent with the findings regarding the number of professional development hours earned by teachers in the three grade categories (Table 9), fewer elementary teachers (8.2%) took six or more courses than did secondary (15.4%) or middle school teachers (22.8%). Although visitation in a demonstration classroom did not appear to related significantly with attitude toward reform, teachers who visited in a demonstration classroom (10.2%) were more likely to express Self or Task concerns ($x^2 = 43.62$, $p < .01$ and $x^2 = 11.88$, $p < .01$, respectively). See Tables 17, 18, and 19.

Outreach Activities that provide teachers with opportunities to share their knowledge and experience with others are descriptive of those in the Outreach category. These activities include conference presentations, published articles, newsletter and/or journal editing, and formal discussions about the reform effort.

Very few teachers reported participation in any of the activities except conference presentations (16.9%) (Tables 20). Teachers who made conference presentations were more likely to express a positive attitude toward reform ($x^2 = 32.32$, $p < .001$) and to express Self, Tasks, or Impact concerns ($x^2 = 37.03$, $p < .001$) (Table 21). Formal discussions with administrators (39%) were reported more frequently than any other group; parents were second (23.8%) (Table 20).

Table 18. Mathematics: Instructional Advancement Participation Frequencies in Professional Organizations; N=362 (Secondary = 117, Middle School =123, Elementary = 122)

	Level of Participation[a]									
	Original Categories								Collapsed Categories	
Variables	None	2	3	4	5	6	7	8	9	10
19. Workshop	70 19.3%	259 71.5%	26 7.2%	0 0%	7 1.9%	0 0%	0 0%	0 0%	292 80.7%	0 0%
% of Secondary	25.6%	64.1%	9.4%	0%	0.9%	0%	0%	0%	74.4%	0%
%of Middle School	17.9%	70.7%	6.5%	0%	4.9%	0%	0%	0%	82.1%	0%
% of Elementary	14.8%	79.5%	5.7%	0%	0%	0%	0%	0%	85.2%	0%

	None	1 course	2-5 courses	6-10 courses	More than 10 courses
20. Graduate Classes	173 47.8%	45 12.4%	88 24.3%	29 8.0%	27 7.5%
% of Secondary	47.9%	11.1%	25.6%	5.1%	10.3%
%of Middle School	47.2%	10.6%	19.5%	12.2%	10.6%
% of Elementary	48.4%	15.6%	27.9%	6.6%	1.6%

	No	Yes
28. New Standards Project	342 94.7%	19 5.3%

	No	Yes
30. Model Classroom Visitor[b]	280 77.3%	37 10.2%

a Participation in lower levels is assumed in higher levels. Percentages of the first 8 categories add to 100; percentages of the last two categories add to 100. See page 22 for explanation of code.

b Percentages do not add to 100; some respondents gave responses. that are presented in Table 16 under Model Classroom Teacher.

Table 19. Mathematics: SoC1 and SoCPN with Instructional Advancement Participation Variable; N=362

	SoC 1				N %	SoCPN		N %
Variables	AI[a]	Self	Tasks	Impact		Positive	Negative	
19. Workshop								
None	25 35.7%	21 30%	19 27.1%	5 7.1%	70 19.3%	22 31.4%	48 68.6%	70 19.3%
not ICTM,not NCTM	56 19.2%	102 34.9%	77 26.4%	57 19.5%	292 80.7%	149 51.0%	143 49.0%	292 80.7%
ICTM, NCTM	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%	0 0%
Column Total	81 22.4%	123 34.0%	96 26.5%	62 17.1%	362 100%	171 47.2%	191 52.8%	392 100%

Chi-square = 12.36, $p < .01$

Chi-square = 8.70, $p < .01$

a Awareness/Informational

Table 20. Mathematics: Outreach Participation Frequencies in Professional Organizations; N=362 (Secondary = 117, Middle School =123, Elementary = 122)

	Level of Participation[a]									
		Original Categories							Collapsed Categories	
Variables	None	2	3	4	5	6	7	8	9	10
14. Conference	301	37	1	16	0	0	1	6	38	23
Presentations	83.1%	10.2%	0.3%	4.4%	0%	0%	0.3%	1.7%	10.5%	6.4%
% of Secondary	81.2%	11.1%	0%	6.0%	0%	0%	0%	1.7%	11.1%	7.7%
% of Middle School	82.1%	8.9%	0.8%	6.5%	0%	0%	0%	1.6%	9.8%	8.1%
% of Elementary	86.1%	10.7%	0%	0.8%	0%	0%	0.8%	1.6%	10.7%	3.3%
12. Articles	352	1	0	4	0	0	4	1	1	9
Contributed	97.2%	0.3%	0%	1.1%	0%	0%	1.1%	0.3%	0.3%	2.5%
13. Articles	354	0	0	5	0	0	2	1	0	8
Published	97.8%	0%	0%	1.4%	0%	0%	0.6%	0.3%	0%	2.2%
26. Journal Editor	359	0	0	2	1	0	0	0	1	2
	99.2%	0%	0%	0.6%	0.3%	0%	0%	0%	0.3%	0.6%
27. Newsletter Editor	358	0	0	2	1	0	1	0	1	3
	98.9%	0%	0%	0.6%	0.3%	0%	0.3%	0%	0.3%	0.8%

	None	Parents	Business	Legislative Rep	Students	Administrators	Family/ Friends	Other
18. Discuss Formally[b]	45.3%	23.8%	4.4%	1.1%	16.6%	39.0%	9.7%	6.4%

[a] Participation in lower levels is assumed in higher levels. Percentages of the first 8 categories add to 100; percentages of the last two categories add to 100. See page 22 for explanation of code.

[b] Percentages do not add to 100; some respondents gave multiple responses.

Table 21 Mathematics SoC1 and SoCPN with Outreach Participation Variable; N=362

Variables	AI[a]	Self	Tasks	Impact	N %	Positive	Negative	N %
	SoC 1					SoCPN		
14. Conference Presentation								
None	75	106	84	36	301	122	179	301
	24.9%	35.2%	27.9%	12%	83.1%	40.5%	59.5%	83.1%
not ICTM,not NCTM	4	9	7	18	38	30	8	38
	10.5%	23.7%	18.4%	47.4%	10.5%	78.9%	21.1%	10.5%
ICTM, NCTM	2	8	5	8	23	19	4	23
	8.7%	34.8%	21.%	34.8%	6.4%	82.6%	17.4%	6.4%
Column Total	81	123	96	62	362	171	191	392
	22.4%	34.0%	26.5%	17.1%	100%	47.2%	52.8%	100%
Chi-square = 37.03,	p < .001					Chi-square = 32.32, p < .001		
12. Articles Contributed								
None	81	119	95	57	352			
	23%	33.8%	27.0%	16.2%	97.2%			
not ICTM,not NCTM	0	1	0	0	1			
	0%	100%	0%	0%	0.3%			
ICTM, NCTM	0	3	1	5	9			
	0%	33.3%	11.1%	55.6%	2.5%			
Column Total	81	123	96	62	362			
	22.4%	34.0%	26.5%	17.1%	100%			

Chi-square = 12.80, p < .05

[a] Awareness/Informational

Science

Many state and national organizations exist through which members can be informed of the science curriculum reform issues; for example, the Iowa Science Teachers Section of the Iowa Academy of Science (ISTS) , the Elementary Science Teachers Section of the Iowa Academy of Science (ESTS), the National Science Teachers Association (NSTA), the American Association of PhysicsTeachers (AAPT), the National Association of Biology Teachers, (NABT) ,etc.. Five categories were identified for the level of participation in science/ science education organizations:

(1) No participation,

(2) Participation in local and/or area activities within the state,

(3) Participation in state activities,

(4) Participation in national but not state activities, and

(5) Participation in state and national activities.

Passive The definition of a passive activity for science is identical to the one stated for mathematics; the activities reported are membership, conference attendance, reading journals, and informal discussions. A difference is the distinction made for science between science education organizations and organizations specific to a topic within the discipline, such as biology, chemistry, physics, etc. Membership, therefore, is listed for both types of organizations. Membership in state and/or national science education organizations was reported by more teachers than membership in a science discipline organization: 51.7% of the teachers reported memberships in an education organization and 20.1% in a science discipline organization. Sixty (18.2%) teachers reported memberships in both kinds of organizations. Secondary teachers reported more memberships overall than middle school or elementary teachers: 62.7% of the secondary teachers reported science education organization memberships, 37.3% reported science discipline organization membership. Elementary teachers reported the least number of memberships. Teachers who reported national science education organization memberships were more likely to express positive attitudes toward the reform ($x^2 = 13.65$, $p < .01$). See Tables 22 and 23.

Participation in state and/or national science education organization conferences was reported by more than half of the teachers with the majority being secondary and middle school/junior high teachers: 62.7% of the secondary teachers and 63.4% of the middle school/junior high teachers. A majority of the teachers reported reading journals (88.1%); 32.2% reported reading every month. Self or Task concerns and a positive inclination toward the reform were more frequently expressed by teachers who attended state and/or national conferences ($x^2 = 32.53$, $p < .01$ and $x^2 = 20.09$, $p < .001$, respectively) and by teachers who reported reading journals more than occasionally ($x^2 = 48.34$, $p < .001$ and $x^2 = 9.64$, $p < .05$, respectively). See Tables 22 and 23.

Informal discussions about the reform effort occurred more often between teachers and colleagues (82.4%), administrators (46.8%), parents (41.6%) and with family and friends (40.7%). Discussions with school boards and in graduate courses were omitted from the questionnaire but included in the counts for parents and family/friends. See Table 22.

Leadership 1 (Committee Member) Leadership commitments for science are defined similarly to the ones listed for mathematics. The activities are membership of an organization committee, a reform project, an executive board, curriculum writing committee, or a curriculum project.

Some teachers (37.4%) reported serving on local and/or area committees but few reported state and/or national committees. Of the 94 teachers (28.6%) who reported working on state and/or national reform projects, the majority were secondary and middle school teachers. Approximately one-third of the teachers reported participating in curriculum writing every few years (35.6%) and every year (32.2%). Only about one-fourth of the teachers reported participation on a curriculum project (26.4%). See Table 24. Teachers who did not serve on a committee, work on a reform project, participate in curriculum writing, or work on a curriculum project more frequently expressed Awareness/Information or Self concerns ($x^2 = 24.06$, $p < .001$; $x^2 = 42.94$, $p < .001$; $x^2 = 31.75$, $p < .001$; and $x^2 = 35.16$, $p < .05$, respectively). See Tables 25 and 26.

Table 22. Science: Passive Participation Frequencies in Professional Organizations; N=329 (Secondary = 110, Middle School =104, Elementary = 115)

	Levels of Participation[a]				
Variables	None	2	3	4	5
9. Membership:	157	2	42	43	85
Science Education	47.7%	0.6%	12.8%	13.1%	25.8%
%of Secondary	37.3%	0%	13.6%	13.6%	35.5%
% of Middle School	28.8%	1.9%	17.3%	16.3%	35.6%
% of Elementary	74.8%	0%	7.8%	9.6%	7.8%
10. Membership:	263	0	3	61	2
Science Discipline	79.9%	0%	0.9%	18.5%	0.6%
%of Secondary	62.7%	0%	0%	37.3%	0%
% of Middle School	76.9%	0%	2.9%	18.3%	1.9%
% of Elementary	99.1%	0%	0%	0.9%	0%
12. Attend	157	6	94	27	45
Conferences	47.7%	1.8%	28.6%	8.2%	13.7%
%of Secondary	35.5%	1.8%	30.9%	10.9%	20.9%
% of Middle School	36.5%	0%	36.5%	9.6%	17.3%
% of Elementary	69.6%	3.5%	19.1%	4.3%	3.5%

	Never	Occasionally	Several times/year	Every month
11. Read Journals	39	117	67	106
	11.9%	35.6%	20.4%	32.2%
%of Secondary	6.4%	25.5%	29.1%	39.1%
% of Middle School	4.8%	32.7%	19.2%	43.3%
% of Elementary	23.5%	47.8%	13.0%	15.7%

	None	Parents	Business	Legislative Rep	Students	Colleague	Adminis tration	Family/ Friends
24. Discuss Informally[b]	11.6%	41.6%	10.3%	5.2%	37.7%	82.4%	46.8%	40.7%

a Participation in lower levels is assumed in higher levels. See page 35 for explanation of code.

b Percentages do not add to 100; some respondents gave multiple responses.

Table 23. Science: SoC1 and SoCPN with Passive Participation Variable; N=329

	SoC 1				N %	SoCPN		N %
Variables	AI[a]	Self	Tasks	Impact		Positive	Negative	
Membership 9. Science Education								
None	55 35.0%	41 26.1%	55 35.0%	6 3.8%	157 47.7%	79 50.3%	78 49.7%	157 47.7%
Local, Area	0 0%	2 100%	0 0%	0 0%	2 0.6%	1 50%	1 50%	2 0.6%
State	8 19%	20 47.6%	13 31.0%	1 2.4%	42 12.8%	21 50.0%	21 50.0%	42 12.8%
National, not State	14 32.6%	15 34.9%	12 27.9%	2 4.7%	43 13.1%	28 65.1%	15 34.9%	43 13.1%
State, National	13 15.3%	28 32.9%	26 30.6%	18 21.2%	85 25.8%	62 72.9%	23 27.1%	85 25.8%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%	191 58.1%	138 41.9%	329 100%
Chi-square = 42.84,	p < .001					Chi-square = 13.65, p < .01		
12. Attend Conferences								
None	57 36.3%	46 29.3%	46 29.3%	8 5.1%	157 47.7%	81 51.6%	76 48.4%	157 47.7%
Local, Area	2 33.3%	2 33.3%	2 33.3%	0 0%	6 1.8%	2 33.3%	4 66.7%	6 1.8%
State	22 23.4%	30 31.9%	34 36.2%	8 8.5%	94 28.6%	50 53.2%	44 46.8%	94 28.6%
National, not State	6 22.2%	14 51.9%	6 22.2%	1 3.7%	27 8.2%	22 81.5%	5 18.5%	27 8.2%
State, National	3 6.7%	14 31.1%	18 40.0%	10 22.2%	45 13.7%	36 80.0%	9 20.0%	45 13.7%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%	191 58.1%	138 41.9%	329 100%
Chi-square = 32.53,	p < .01					Chi-square = 20.09, p < .001		
11. Reading Journals								
None	18 46.2%	7 17.9%	14 35.9%	0 0%	39 11.9%	21 53.8%	18 46.2%	39 11.9%
Occasionally	38 32.5%	39 33.3%	38 32.5%	2 1.7%	117 35.6%	56 47.9%	61 52.1%	117 35.6%
Several time/year	12 17.9%	31 46.3%	21 31.3%	3 4.5%	67 20.4%	44 65.7%	23 34.3%	67 20.4%
Every month	22 20.8%	29 27.4%	33 31.1%	22 20.8%	106 32.2%	70 66.0%	36 34.0%	106 32.2%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%	191 58.1%	138 41.9%	329 100%
Chi-square = 48.34,	p < .001					Chi-square = 9.64, p < .05		

[a] Awareness/Informational

Table 24 Science: Leadership 1 (Committee Member) Participation Frequencies in Professional Organizations, N=329 (Secondary = 110, Middle School =104, Elementary = 115

	Levels of Participation[a]				
Variables	None	2	3	4	5
17. Reform Project	230	5	42	30	22
	69.9%	1.5%	12.8%	9.1%	6.7%
%of Secondary	69.1%	0%	12.7%	9.1%	9.1%
% of Middle School	51.9%	2.9%	23.1%	11.5%	10.6%
% of Elementary	87.0%	1.7%	3.5%	7.0%	0.9%
19. Organization Committee	201	123	5	0	0
	61.1%	37.4%	1.5%	0%	0%
%of Secondary	53.6%	41.8%	4.5%	0%	0%
% of Middle School	46.2%	53.8%	0%	0%	0%
% of Elementary	81.7%	18.3%	0%	0%	0%
21. Executive Board	305	18	5	1	0
	92.7%	5.5%	1.5%	0.3%	0%
%of Secondary	88.2%	9.1%	2.7%	0%	0%
% of Middle School	93.3%	5.8%	1.0%	0%	0%
% of Elementary	96.5%	1.7%	0.9%	0.9%	0%

	None	Infrequently	Every few years	Every year
15. Curriculum Writing	66	40	117	106
	20.1%	12.2%	35.6%	32.2%
%of Secondary	9.1%	10.0%	40.0%	40.9%
% of Middle School	17.3%	10.6%	31.7%	40.4%
% of Elementary	33.0%	15.7%	34.8%	16.5%

	None	Writer	Tester	Writer, Tester	Local Adoption	Writer, Adoption	Tester, Adoption	All 3
16. Curriculum Project	242	13	21	11	27	1	4	10
	73.6%	4.0%	6.4%	3.3%	8.2%	0.3%	1.2%	3.0%
%of Secondary	73.6%	8.2%	7.3%	1.8%	3.6%	0%	0.9%	4.5%
% of Middle School	64.4%	1.9%	8.7%	7.7%	9.6%	1.0%	2.9%	3.8%
% of Elementary	81.7%	1.7%	3.5%	0.9%	11.3%	0%	0%	0.9%

[a] Participation in lower levels is assumed in higher levels. See page 35 for explanation of code.

Table 25. Science: SoC1 and SoCPN with Leadership 1 (Committee Member - Organization, Reform Project, Executive Board) Participation Variable; N=329

	SoC 1				N %
Variables	AI^a	Self	Tasks	Impact	
17. Reform Project					
None	77 33.5%	68 29.6%	75 32.6%	10 4.3%	230 69.9%
Local, Area	2 40.0%	0 0%	2 40.0%	1 20.0%	5 1.5%
State	9 21.4%	17 40.5%	11 26.2%	5 11.9%	42 12.8%
National, not State	1 3.3%	15 50.0%	10 33.3%	4 13.3%	30 9.1%
State, National	1 4.5%	6 27.3%	8 36.4%	7 31.8%	22 6.7%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%
Chi-square = 42.94,	p < .001				
19. Organization					
None	70 34.8%	66 32.8%	54 26.9%	11 5.5%	201 61.1%
Local, Area	20 16.3%	39 31.7%	48 39.0%	16 13.0%	123 37.4%
State	0 0%	1 20.0%	4 80.0%	0 0%	5 1.5%
National, not State	0 0%	0 0%	0 0%	0 0%	0 0%
State, National	0 0%	0 0%	0 0%	0 0%	0 0%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%
Chi-square = 24.06,	p < .001				
21. Executive Board					
None	86 28.2%	104 34.1%	93 30.5%	22 7.2%	305 92.7%
Local, Area	3 16.7%	2 11.1%	9 50.0%	4 22.2%	18 5.5%
State	0 0%	0 0%	4 80.0%	1 20.0%	5 1.5%
National, not State	1 100%	0 0%	0 0%	0 0%	1 0.3%
State, National	0 0%	0 0%	0 0%	0 0%	0 0%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%

Chi-square = 20.40, p < .05

a Awareness/Informational

Table 26. Science: SoC1 and SoCPN with Leadership 1 (Committee Member - Curriculum Writing) Participation Variable; N=329

	SoC 1				N %
Variables	AI^a	Self	Tasks	Impact	
15. Curriculum Writing					
None	31 47.0%	16 24.2%	14 21.2%	5 7.6%	66 20.1%
Infrequently	15 37.5%	10 25.0%	12 30.0%	3 7.5%	40 12.2%
Every few years	31 26.5%	41 35.0%	40 34.2%	5 4.3%	117 35.6%
Every year	13 12.3%	39 36.8%	40 37.7%	14 13.3%	106 32.2%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%
Chi-square = 31.75,	p < .001				
16. Curriculum Project					
None	74 30.6%	79 32.6%	75 31.0%	14 5.8%	242 73.6%
Writer	0 0%	4 30.8%	6 46.2%	3 23.1%	13 4.0%
Tester	5 23.8%	11 52.4%	4 19.0%	1 4.8%	21 6.4%
Writer, Tester	1 9.1%	4 36.4%	4 36.4%	2 18.2%	11 3.3%
Local Adoption	9 33.3%	3 11.1%	12 44.4%	3 11.1%	27 8.2%
Writer, Adoption	0 0%	0 0%	1 100%	0 0%	1 0.3%
Tester, Adoption	0 0%	2 50.0%	1 25.0%	1 25.0%	4 1.2%
All 3	1 10.0%	3 30.0%	3 30.0%	3 30.0%	10 3.0%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%

Chi-square = 35.16, p < .05

a Awareness/Informational

Table 27. Science: Leadership 2 (Committee Chair) Participation Frequencies in Professional Organizations. N=329 (Secondary = 110, Middle School =104, Elementary = 115)

	Levels of Participation[a]				
Variables	None	2	3	4	5
20. Organization	267	58	2	1	1
Committee	81.2%	17.6%	0.6%	0.3%	0.3%
%of Secondary	73.6%	23.6%	1.8%	0%	0.9%
% of Middle School	76.0%	24.0%	0%	0%	0%
% of Elementary	93.0%	6.1%	0%	0.9%	0%
22. Regional Director	326	0	1	2	0
	99.1%	0%	0.3%	0.6%	0%
23. Elected Officer	308	13	4	4	0
	93.6%	4.0%	1.2%	1.2%	0%
%of Secondary	90.9%	4.5%	2.7%	1.8%	0%
% of Middle School	91.3%	6.7%	1.0%	1.0%	0%
% of Elementary	98.3%	0.9%	0%	0.9%	0%

	Teacher	Visitor and Teacher
18. Model Classroom	43	15
Teacher[b]	13.1%	4.6%

a Participation in lower levels is assumed in higher levels. See page 35 for explanation of code.

b Percentages do not add to 100; some respondents gave responses. that are presented in Table 29 under Model Classroom Visitor.

Table 28. Science: SoC1 and SoCPN with Leadership 2 (Committee Chair) Participation Variable; N=329

	SoC 1				N
Variables	AI[a]	Self	Tasks	Impact	%
18. Model Classroom Teacher					
No	69 31.8%	70 32.3%	72 33.2%	6 2.8%	217 66.0%
Visitor	16 29.6%	20 37.0%	15 27.8%	3 5.6%	54 16.4%
Teacher	4 9.3%	12 27.9%	13 30.2%	14 32.6%	43 13.1%
Visitor and Teacher	1 6.7%	4 26.7%	6 40.0%	4 26.7%	15 4.6%
Column Total	90 27.4%	106 32.2%	106 32.2%	27 8.2%	329 100%

Chi-square = 56.24, $p < .001$

a Awareness/Informational

Leadership 2 (Committee Chair) The Leadership 2 category activities for science include serving as chair of an organization committee, serving as a regional director, and serving as an elected officer of an organization. Also included in this category is serving as a demonstration teacher in the demonstration classroom program.

Few teachers reported serving as a regional director, chair for a committee, or holding an elected office; those who reported participated primarily in local and/or area level organizations. Local and/or area level participation was reported by 17.6% of the teachers for committee chair and 4% for an elected office. Fifty-eight (17.6%) teachers have served as a demonstration teacher in the demonstration classroom project (Table 27). The demonstration teachers were more likely to express Self, Task, or Impact concerns; all other teachers expressed Awareness/Information, Self, or Tasks concerns ($x^2 = 56.24$, $p < .001$) (Table 28). Attitude did not appear to relate significantly with the demonstration teacher role.

Instructional Advancement Instructional Advancement activities develop and strengthen a teacher's professional and academic preparation for teaching science particularly in current curriculum reform issues. Workshops, graduate courses, and visitation in a demonstration classroom project are included in this category.

The majority of teachers (72.9%) reported participating in local and/or area level workshops and 11.6% reported participating in state level workshops. More than half (59.6%) of the teachers have enrolled in at least one graduate level course (Table 29). Self or Task concerns were more frequently expressed by teachers who reported taking at least one course compared to the Awareness/Information concerns expressed by those who had not taken any courses ($x^2 = 25.46$, $p < .05$) (Table 30). Somewhat consistent with the findings regarding the number of professional development hours earned by teachers in the three grade categories (Table 9), a large proportion of elementary teachers (91.2%) took less than six courses. The 54 teachers who visited in a model classroom were more likely to express Self concerns ($x^2 = 56.24$, $p < .001$) (Table 28).

Outreach Activities that provide teachers with opportunities to share their knowledge and experience with others include conference presentations, published articles, and formal discussions about the reform effort.

Very few teachers reported participation in any of the activities except conference presentations (19.6%). Teachers who expressed Awareness/Information concerns were more likely to have not made any conference presentations ($x^2 = 42.56$, $p < .001$). Formal discussions with colleagues (48.9%) were reported more frequently than any other group; administrators (29.5%) and parents (10%) were also reported. See Tables 31 and 32.

Philosophy and Content

The relationship between a individual's set of beliefs and attitudes and that of a group is an indicator of the acceptance or rejection of an innovation (Havelock, 1969; Lewin, 1947). Accepting an innovation often requires an adjustment to one's belief system. This is a very personal and individual process that may be painful if the implementation process is not addressed properly. An understanding of a teacher's philosophical stance and understanding of the innovation's content is key to designing appropriate intervention strategies (i.e., inservice activities such as workshops).

The content of the questions in the Philosophy and Content section was based on the philosophy supporting the NCTM Standards and the NRC Standards. The responses gathered information on the consistency of a teacher's philosophy and understanding of mathematics/science education to the underlying philosophy and content of the current mathematics/ science curriculum reform frameworks. The questions were placed into six categories: Tracking, Cooperative Groups, Technology, Assessment, Instruction, and Beliefs. The question responses were a Likert scale where 1 represented strongly agree (SA), 2 agree (A), 3 neutral, 4 disagree (D), and 5 strongly disagree (SD). The five responses were collapsed into three categories for crosstabulation analysis: SA/A, Neutral, SD/D.

Table 29. Science: Instructional Advancement Participation Frequencies in Professional Organizations. N=329 (Secondary = 110, Middle School =104, Elementary = 115)

	Levels of Participation[a]				
Variables	None	2	3	4	5
26. Workshop	31	240	38	11	9
	9.4%	72.9%	11.6%	3.3%	2.7%
%of Secondary	9.1%	70.0%	10.9%	7.3%	2.7%
% of Middle School	4.8%	76.0%	11.5%	1.9%	5.8%
% of Elementary	13.9%	73.0%	12.2%	0.9%	0%
	None	1 course	2-5 courses	6-10 courses	More than 10 courses	Other
27. Graduate Classes	133	29	72	34	57	4
	40.4%	8.8%	21.9%	10.3%	17.3%	1.2%
%of Secondary	34.5%	8.2%	18.2%	15.5%	22.7%	0.9%
% of Middle School	23.1%	7.7%	28.8%	11.5%	26.9%	1.9%
% of Elementary	61.7%	10.4%	19.1%	4.3%	3.5%	0.9%
		No			Yes	
18. Model Classroom Visitor[b]		217			54	
		66.0%			16.4%	

a Participation in lower levels is assumed in higher levels. See page 35 for explanation of code.

b Percentages do not add to 100; some respondents gave responses that are presented in Table 27 under Model Classroom Teacher.

Table 30. Science: SoC1 and SoCPN with Instructional Advancement Participation Variable; N=329

	SoC 1				N
Variables	AI[a]	Self	Tasks	Impact	%
27. Graduate Classes					
None	47	35	45	6	133
	35.3%	26.3%	33.8%	4.5%	40.4%
1 course	9	10	7	3	29
	31.0%	34.5%	24.1%	10.3%	8.8%
2-5 courses	18	21	25	8	72
	25.0%	29.2%	34.7%	11.1%	21.9%
6-10 courses	10	15	8	1	34
	29.4%	44.1%	23.5%	2.9%	10.3%
More than 10 courses	6	24	19	8	57
	10.5%	42.1%	33.3%	14.0%	17.3%
Other	0	1	2	1	4
	0%	25.0%	50.0%	25.0%	1.2%
Column Total	90	106	106	27	329
	27.4%	32.2%	32.2%	8.2%	100%

Chi-square =25.46, $p < .05$

a Awareness/Informational

Table 31. Science: Outreach Participation Frequencies in Professional Organizations, N=329 (Secondary = 110, Middle School =104, Elementary = 115)

	Levels of Participation[a]				
Variables	None	2	3	4	5
14. Conference	254	49	0	10	2
Presentations[b]	80.6%	15.6%	0%	3.2%	0.6%
%of Secondary	76.4%	14.5%	0%	3.6%	1.8%
% of Middle School	65.4%	22.1%	0%	3.8%	0%
% of Elementary	88.7%	8.7%	0%	1.7%	0%
13. Articles	314	1	4	6	4
Published	95.4%	0.3%	1.2%	1.8%	1.2%

	None	Parents	Business	Legislative Rep	Students	Colleague	Administration	Family/ Friends
25. Discuss Formally[c]	45.6%	10.0%	4.9%	3.0%	9.7%	48.9%	29.5%	4.6%

a Participation in lower levels is assumed in higher levels. See page 35 for explanation of code.
b Some teachers did not respond to this question.
c Percentages do not add to 100; some respondents gave multiple responses.

Table 32. Science: SoC1 and SoCPN with Outreach Participation Variable; N=329

	SoC 1				N
Variables	AI[a]	Self	Tasks	Impact	%
14. Conference Presentations					
None	83	84	77	10	254
	32.7%	33.1%	30.3%	3.9%	80.6%
Local, Area	5	13	18	13	49
	10.2%	26.5%	36.7%	26.5%	15.6%
State	0	0	0	0	0
	0%	0%	0%	0%	0%
National, not State	1	5	3	1	10
	10.0%	50.0%	30.0%	10.0%	3.2%
State, National	0	0	2	0	2
	0%	0%	100%	0%	0.6%
Column Total	89	102	100	24	315
	28.3%	32.4%	31.7%	7.6%	100%
Chi-square =42.56,	p < .001				
13. Articles Published					
None	87	101	104	22	314
	27.7%	32.2%	33.1%	7.0%	95.4%
Local, Area	1	0	0	0	1
	100%	0%	0%	0%	0.3%
State	0	2	1	1	4
	0%	50.0%	25.0%	25.0%	1.2%
National, not State	2	2	0	2	6
	33.3%	33.3%	0%	33.3%	1.8%
State, National	0	1	1	2	4
	0%	25.0%	25.0%	50.0%	1.2%
Column Total	90	106	106	27	329
	27.4%	32.2%	32.2%	8.2%	100%

Chi-square =22.59, p < .05

[a] Awareness/Informational

The questions were assigned to a category based upon a connective theme. All of the questions in the Tracking category centered on the perceived outcome of heterogeneous or homogeneous grouping of students. The theme of the Cooperative Group category questions was the benefit of students working independently or in groups to solve problems. Questions referring to the appropriate use of calculators and/or computers in instruction and the use of alternative assessment of student performance were in the Technology and Assessment categories, respectively. The Instruction category consisted of questions focused on the use of real-life applications, the role of drill problems, the use of textbooks, the use of alternative teaching strategies, and the role of problem-solving activities in instruction. Questions in the Belief category centered on global student outcomes such as learning to value mathematics/science, becoming confident in their own ability to learn mathematics/ science, the role of school mathematics/science programs in attaining these goals, and the role of the school and parents in achieving the student goals. See Appendix A for a copy of the questions.

Mathematics

An aggregate view of the responses indicates a general consensus of agreement with the underlying NCTM philosophy. A majority of responses on all questions except one (#34) was in support of a NCTM standards-based view. This would lead to a superficial conclusion that K-12 teachers in Iowa are well on their way to implementing curriculum reform. A closer analysis of responses, however, reveals the topics with which teachers are not in agreement.

Tracking. Responses on the three questions in this category indicate that, in general, teachers do not agree that grouping students homogeneously fosters better learning than heterogeneous grouping. A majority of the teachers disagree/ strongly disagree that homogeneous groups foster better learning than heterogeneous (51.1%), that tracking by ability encourages mathematics for all students (50.8%), and 49.5% agree/strongly agree that students learn more in heterogeneous grouped classes (Table 33). Teachers who agree/strongly agree with the last

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statement were more likely to express Self, Task, or Impact concerns; those who disagree/strongly disagree were more likely to express Awareness/Information, Self, or Task concerns ($x^2 = 16.96$, $p < .01$) (Table 34).

By grade level, elementary teachers were more likely to disagree/strongly disagree that homogeneous groups foster better learning ($x^2 = 57.08$, $p < .001$), that tracking by ability encourages mathematics for all students ($x^2 = 26.81$, $p < .001$), and to agree/strongly agree that students learn more in heterogeneously grouped classes ($x^2 = 70.91$, $p < .001$). In contrast, secondary teachers were more likely to agree/strongly agree with the first two questions and disagree/strongly disagree that students learn more in heterogeneously grouped classes. Middle school teachers reported mixed responses to the questions. See Table 34.

An important observation is the relationship between responses on the question, "Tracking by ability encourages mathematics for all students" and frequencies of positive or negative attitudes toward reform. Teachers who agree/strongly agree with tracking by ability were more likely to have a negative view of the reform effort; teachers who disagree/strongly disagree to have positive attitudes ($x^2 = 10.09$, $p < .01$) (Table 34).

Cooperative Learning Groups A majority of the teachers expressed their support of the use of cooperative learning groups in instruction. Eighty-seven percent disagree/strongly disagree that cooperative learning groups are a hindrance, 79.3% disagree/strongly disagree that it is important for students to learn how to work independently rather than to work with others, and 85.9% disagree/strongly disagree that working independently is a skill needed for the future. Teachers who disagree/strongly disagree on the first two questions were more likely to express Self concerns ($x^2 = 17.85$, $p < .01$ and $x^2 = 13.93$, $p < .05$, respectively) and teachers who agree/strongly agree were more likely to have negative attitudes toward the reform ($x^2 = 9.52$, $p < .01$ and $x^2 = 8.19$, $p < .05$, respectively) . See Tables 33 and 35.

Table 33. Mathematics: Frequencies of Philosophy and Content Variables in Tracking and Cooperative Group Categories. N = 362.

Variables	Responses					
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Missing
Tracking						
34. Homogeneous groups (students of similar abilities) foster better learning than heterogeneous.	37 10.2%	109 30.1%	30 8.3%	150 41.4%	35 9.7%	1 0.3%
37. Tracking by ability encourages mathematics for all students.	15 4.1%	93 25.7%	70 19.3%	144 39.8%	40 11.0%	0 0%
47. Students learn more in heterogeneously grouped classes.	39 10.8%	140 38.7%	68 18.8%	106 29.3%	8 2.2%	1 0.3%
Cooperative Groups						
48. Cooperative learning groups are a hindrance in mathematics instruction.	2 0.6%	11 3.0%	33 9.1%	208 57.5%	108 29.8%	0 0%
55. It is more important for students to learn how to work independently rather than to work with others on solving problems.	7 1.9%	40 11.0%	27 7.5%	242 66.9%	45 12.4%	1 0.3%
61. Skills needed for the 21st century are acquired by working independently to solve explicit sets of drill and practice exercises.	6 1.7%	16 4.4%	28 7.7%	176 48.6%	135 37.3%	1 0.3%

Table 34. Mathematics: Philosophy and Content Tracking Variables With Grade, SoC1, and SoCPN; N=362

	Grade			SoC 1				SoCPN		N %
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	
34. Homogeneous groups (students of similar abilities) foster better learning than heterogeneous.										
SA/A	67	61	18							146
	45.9%	41.8%	12.3%							40.3%
Neutral	11	10	9							30
	37.7%	33.3%	30%							8.3%
SD/D	39	52	95							186
	21.1%	28.1%	51.1%							51.4%
Column Total	117	123	122							362
	32.4%	34.1%	33.7%							100%
Chi-square = 57.08, p < .001, r = .37										
37. Tracking by ability encourages mathematics for all students.										
SA/A	50	41	17	20	44	35	9	42	66	108
	46.3%	38.0%	15.7%	18.5%	40.7%	32.4%	8.3%	38.9%	61.1%	29.8%
Neutral	23	19	28	17	20	24	9	27	43	70
	32.9%	27.1%	40%	24.3%	28.6%	34.3%	12.9%	38.6%	61.4 %	19.3%
SD/D	44	63	77	44	59	37	44	102	82	184
	23.9%	34.2%	41.8%	23.9%	32.1%	20.1%	23,9%	55.4%	44.6%	50.8%
Column Total	117	123	122	81	123	96	62	171	191	362
	32.3%	34.0%	33.7%	22.4%	34.0%	26.5%	17.1%	47.2%	52.8%	100%
Chi-square = 26.81, p < .001				Chi-square = 19.70, p < .01				Chi-square = 10.09, p < .01		
47. Students learn more in heterogeneously grouped classes.										
SA/A	27	62	91	38	57	42	43			180
	15.0%	34.4%	50.6%	21.1%	31.7%	23.3%	23.9%			49.7%
Neutral	29	19	20	16	19	26	7			68
	42.6%	27.9%	29.4%	23.5%	27.9%	38.2%	10.3%			18.8%
SD/D	61	42	11	27	47	28	12			114
	53.5%	36.8%	9.6%	23.7%	41.2%	24.6%	10.5%			31.5%
Column Total	117	123	122	81	123	96	62			362
	32.4%	34.1%	33.7%	22.4%	34.0%	26.5%	17.1%			100%
Chi-square = 70.91, p < .001				Chi-square = 16.96, p < .01						

a Awareness/Informational

Table 35. Mathematics: Philosophy and Content Cooperative Group Variables with Grade, SoC1, and SoCPN; N = 362

	Grade			SoC 1				SoCPN		N
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	%
48. Cooperative learning groups are a hindrance in mathematics instruction.										
SA/A				3	5	8	1	3	10	13
				23.1%	38.5%	30.1%	7.7%	23.1%	76.9%	3.6%
Neutral				4	12	17	0	9	24	33
				12.1%	36.4%	51.5%	0%	27.3%	72.7%	9.1%
SD/D				74	106	75	61	159	157	316
				23.4%	33.5%	23.7%	19.3%	50.3%	49.7%	87.3%
Column Total				81	123	96	62	171	191	362
				22.4%	34.0%	26.5%	17.1%	47.2%	52.8%	100%
				Chi-square = 17.85, p < .01				Chi-square = 9.52, p < .01		
55. It is more important for students to learn how to work independently rather than to work with others on solving problems.										
SA/A				10	17	17	3	15	32	47
				21.3%	36.2%	36.2%	6.4%	31.9%	68.1%	13.0%
Neutral				5	9	12	1	9	18	27
				18.5%	33.3%	44.4%	3.7%	33.3%	66.7%	7.5%
SD/D				66	97	67	58	147	141	288
				22.9%	33.7%	23.3%	20.1%	51.0%	49.0%	79.6%
Column Total				81	123	96	62	171	191	362
				22.4%	34.0%	26.5%	17.1%	47.2%	52.8%	100%
				Chi-square = 13.93, p < .05				Chi-square = 8.19, p < .05		
61. Skills needed for the 21st century are acquired by working independently to solve explicit sets of drill and practice exercises.										
SA/A	7	8	7							22
	31.8%	36.4%	31.8%							6.1%
Neutral	16	4	8							28
	57.1%	14.3%	28.6%							7.8%
SD/D	94	111	107							312
	30.1%	35.6%	34.3%							86.2%
Column Total	117	123	122							321
	32.3%	34.0%	33.7%							100%

Chi-square = 9.55, p < .05

[a] Awareness/Informational

Technology The appropriate use of calculators and computers is supported by a majority of teachers. Sixty-two percent disagree/strongly disagree that calculator use will inhibit learning basic computation skills, 90.6% agree/strongly agree that calculators should be an integral tool, 72.1% disagree/strongly disagree that computers are best used as tools for writing or record keeping, and 84.5% disagree/strongly disagree that the calculator reduces the need for estimation and approximation skills (Table 36). Elementary teachers were more likely to disagree/strongly disagree that calculators inhibit learning basic computation skills ($x^2 = 14.31$, $p < .01$) or that computers are best used as writing or record keeping tools ($x^2 = 12.38$, $p < .05$). See Table 37.

On the question of whether or not basic computation skills are inhibited by calculator use and if writing or record keeping is the best use of computers, teachers who disagree/strongly disagree were more likely to express a positive inclination toward the reform effort while teachers who agree/strongly agree to have a negative view ($x^2 = 7.80$, $p < .05$ and $x^2 = 6.75$, $p < .05$, respectively) (Table 37).

Assessment A majority of teachers' views closely align philosophically with the NCTM Standards on the alternative assessment issue. Ninety percent of the teachers agree/strongly agree that well-phrased questions encourage more open-ended investigations, 90.3% agree/strongly agree a variety of alternative assessment strategies should be used, and 64.4% disagree/strongly disagree that evaluation is not an integral part of teaching/learning mathematics. The teachers who expressed a positive attitude toward reform were more likely to disagree/strongly disagree that evaluation is not integral to mathematics teaching or learning ($x^2 = 8.87$, $p < .05$). See Tables 36 and 37.

Instruction Teachers were asked their beliefs on the role of drill vs application problems, the use of the textbook, and the effect of instructional strategies on student learning. Overall, teachers' views closely align with the underlying philosophy of the NCTM Standards except for the need to master computation skills before studying algebra. More than half (56.6%) of the teachers agree/strongly agree that computation must be mastered before studying algebra. Secondary teachers were more likely to believe this than middle school or elementary teachers ($x^2 = 17.36$, $p < .01$). Consistent with this pattern, teachers who agree/strongly agree with the statement were more likely to express Self concerns ($x^2 = 19.40$, $p < .01$) and have negative attitudes toward the reform ($x^2 = 20.32$, $p < .001$). See Tables 38 and 39a.

Elementary teachers were more likely to disagree/strongly disagree that students learn more by working on "drill" problems in class ($x^2 = 35.42$, $p < .001$). Middle school teachers expressed a belief that skill development should precede working on word problems rather than using the experience with word problems to develop the skills ($x^2 = 19.76$, $p < .001$). Negative attitudes toward the reform were more likely to be expressed by teachers who agree/strongly agree that more mathematical power is gained from acquiring strong computational skills than from acquiring the ability to solve nonroutine problems ($x^2 = 11.35$, $p < .01$) and that the overall goal of school mathematics is to increase students' computational skills ($x^2 = 7.27$, $p < .05$). See Tables 39a and 39b.

More than sixty percent support the view that curriculum should not be organized around the textbook but that the textbook should be used as a resource (Table 38). A significant relationship exists between this view and a positive attitude toward the reform ($x^2 = 18.83$, $p < .001$). Elementary teachers were more likely to agree/strongly agree; more secondary teachers disagree/strongly disagree ($x^2 = 23.98$, $p < .001$). See Tables 39a and 39b.

Beliefs Teachers expressed beliefs that philosophically align with the overall goals stated by NCTM. Eighty-eight percent of the teachers agree/strongly agree that almost all children can learn to think mathematically, that parental involvement is important (92.8%), that knowing mathematics is doing mathematics (64.3%), that mathematics should be a pump and not a filter (78.2%), and that learning to value mathematics is important (95.8%). A majority of the teachers also expressed a belief that mathematical ability is demonstrated by the ability to use a variety of methods effectively to solve nonroutine problems (94.8%) and that students who believe in the utility and value of mathematics acquire a mathematical perception of their world (86.2%). A significant relationship exists between agreement/strong agreement that preparation for further study in mathematics is the important goal of

Table 36. Mathematics: Frequencies of Philosophy and Content Variables in Technology and Assessment Categories; N = 362.

Variables	Responses					
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Missing
Technology						
36. Calculator use will inhibit learning basic computation skills.	20 5.5%	86 23.8%	31 8.6%	160 44.2%	65 18.0%	0 0%
39. Calculators should be available to students at all times even when practicing basic computation skills.	15 4.1%	100 27.6%	24 6.6%	187 51.7%	36 9.9%	0 0%
40. Calculators should be available to use at all times except when practicing basic computation skills.	11 3.0%	117 32.3%	34 9.4%	149 41.2%	51 14.1%	0 0%
49. Calculators should be an integral tool in mathematics instruction.	126 34.8%	202 55.8%	15 4.1%	18 5.0%	1 0.3%	0 0%
50. Computers are best used by students as tools for writing or record keeping.	4 1.1%	35 9.7%	61 16.9%	211 58.3%	50 13.8%	1 0.3%
66. The use of a calculator reduces the need for estimation and approximation skills.	2 0.6%	34 9.4%	19 5.2%	181 50.0%	125 34.5%	1 0.3%
Assessment						
45. Well-phrased questions encourage more open-ended investigations.	102 28.2%	226 62.4%	24 6.6%	7 1.9%	3 0.8%	0 0%
51. Instruction should use a variety of alternative assessment strategies.	110 30.4%	217 59.9%	24 6.6%	7 1.9%	3 0.8%	1 0.3%
68. Although evaluation is important it is not an integral part of daily teaching and learning mathematics.	11 3.0%	91 25.1%	27 7.5%	189 52.2%	44 12.2%	0 0%

Table 37. Mathematics: Philosophy and Content Technology and Assessment Variables With Grade, SoC1, and SoCPN
N=362

	Grade			SoC 1				SoCPN		N
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	%
Technology										
36. Calculator use will inhibit learning basic computation skills.										
SA/A	45	37	24					38	68	106
	42.5%	34.9%	22.6%					35.8%	64.2%	29.3%
Neutral	12	12	7					16	15	31
	38.7%	38.7%	22.6%					51.6%	48.4%	8.6%
SD/D	60	74	91					117	108	225
	26.7%	32.9%	40.4%					52.0%	48.0%	62.2%
Column Total	117	123	122					171	191	362
	32.3%	34.0%	33.7%					47.2%	52.8%	100%
Chi-square = 14.31, p < .01								Chi-square = 7.80, p < .05		
50. Computers are best used by students as tools for writing and record keeping.										
SA/A	13	14	12					11	28	39
	33.3%	35.9%	30.8%					28.2%	71.8%	10.8%
Neutral	19	31	11					28	33	61
	31.1%	50.8%	18.0%					45.9%	54.1%	16.9%
SD/D	85	78	99					132	130	262
	32.4%	29.8%	37.8%					50.4%	49.6%	72.3%
Column Total	117	123	122					171	191	362
	32.4%	34.1%	33.7%					47.2%	52.8%	100%
Chi-square = 12.38, p < .05								Chi-square = 6.75,p < .05		
Assessment										
68. Although evaluation is important it is not an integral part of daily teaching and learning mathematics.										
SA/A								40	62	102
								39.2%	60.8%	28.2%
Neutral								8	19	27
								29.6%	70.4%	7.5%
SD/D								123	110	233
								52.8%	47.2%	64.4%
Column Total								171	191	362
								47.2%	52.8%	100%

Chi-square = 8.87, p < .05

a Awareness/Informational

Table 38. Mathematics: Frequencies of Philosophy and Content Variables in Instruction Category; N = 362.

	Responses					
Variables	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Missing
Instruction						
32. Students learn more by working on "drill" problems in class.	3 0.8%	102 28.2%	33 9.1%	165 45.6%	56 15.5%	3 0.8%
35. Learning to perform complex computations with speed and accuracy is important for most students.	21 5.8%	97 26.8%	43 11.9%	170 47.0%	30 8.3%	1 0.3%
38. It is important that students first master computation skills before studying algebra.	53 14.6%	152 42.0%	53 14.6%	87 24.0%	17 4.7%	0 0%
41. Class instructions should not be disrupted by including real-life applications.	6 1.7%	2 0.6%	2 0.6%	86 23.8%	266 73.5%	0 0%
42. Curriculum should be organized around the textbook.	5 1.4%	70 19.3%	48 13.3%	175 48.3%	63 17.4%	1 0.3%
43. Most students understand mathematics better with the use of hands-on materials and manipulatives.	137 37.8%	180 49.7%	31 8.6%	10 2.8%	4 1.1%	0 0%
46. The best use of a textbook is as a resource rather than the primary instructional tool.	69 19.1%	174 48.1%	43 11.9%	72 19.9%	4 1.1%	0 0%
57. Students learn "how to think" regardless of the instructional strategy used.	11 3.0%	48 13.3%	36 9.9%	219 60.5%	47 13.0%	1 0.3%
63. More mathematical power is gained from acquiring strong computational skills than from acquiring the ability to solve nonroutine (not familiar, more than one step) problems.	5 1.4%	32 8.8%	42 11.6%	216 59.7%	66 18.2%	1 0.3%
67. Skill development should precede working on word problems rather than using the experience with word problems to develop the skills.	12 3.3%	72 19.9%	69 19.1%	177 48.9%	32 8.8%	0 0%
69. The overall goal of school mathematics is to increase students' computational skills.	2 0.6%	53 14.6%	33 9.1%	219 60.5%	55 15.2%	0 0%
70. It is more important for students to learn one method rather than a variety of methods to solve nonroutine (not familiar, more than one step) problems.	3 0.8%	11 3.0%	11 3.0%	214 59.1%	123 34.0%	0 0%

Table 39a. Mathematics: Philosophy and Content Instruction Variables With Grade, SoC1, and SoCPN; N=362

	Grade			SoC 1				SoCPN		N
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	%
32. Students learn more by working on "drill" problems in class.										
SA/A	47	30	28	30	40	33	2	27	78	105
	44.8%	28.6%	26.7%	28.6%	38.1%	31.4%	1.9%	25.7%	74.3%	29.0%
Neutral	21	9	3	8	11	8	6	17	16	33
	63.6%	27.3%	9.1%	24.2%	33.3%	24.2%	18.2%	51.5%	48.5%	9.1%
SD/D	49	84	91	43	72	55	54	127	97	224
	21.9%	37.5%	40.6%	19.2%	32.1%	24.6%	24.1%	56.7%	43.3%	61.9%
Column Total	117	123	122	81	123	96	62	171	191	362
	32.3%	34.0%	33.7%	22.4%	34.0%	26.5%	17.1%	47.2%	52.8%	100%
Chi-square = 35.42, p < .001				Chi-square = 25.56, p < .001				Chi-square = 27.80, p < .001		
38. It is more important that students first master computation skills before studying algebra.										
SA/A	79	66	60	54	74	55	22	77	128	205
	38.5%	32.2%	29.3%	26.3%	36.1%	26.8%	10.7%	37.6%	62.4%	56.6%
Neutral	10	14	29	10	18	16	9	27	26	53
	18.9%	26.4%	54.7%	18.9%	34.0%	30.2%	17.0%	50.9%	49.1%	14.6%
SD/D	28	43	33	17	31	25	31	67	37	104
	26.9%	41.3%	31.7%	16.3%	29.8%	24.0%	29.8%	64.4%	35.6%	28.7%
Column Total	117	123	121	81	123	96	62	171	191	362
	32.3%	34.0%	33.7%	22.4%	34.0%	26.5%	17.1%	47.2%	52.8%	100%
Chi-square = 17.36, p < .01				Chi-square = 19.40, p < .01				Chi-square = 20.32, p < .001		
42. Curriculum should be organized around the textbook.										
SA/A	29	31	15	21	28	24	2	20	55	75
	38.7%	41.3%	20.0%	28.0%	37.3%	32.0%	2.7%	26.7%	73.3%	20.7%
Neutral	17	17	14	13	14	16	5	20	28	48
	35.4%	35.4%	29.2%	27.1%	29.2%	33.3%	10.4%	41.7%	58.3%	13.3%
SD/D	71	75	93	47	81	56	55	131	108	239
	29.7%	31.4%	38.9%	19.7%	33.9%	23.4%	23.0%	54.8%	45.2%	66.0%
Column Total	117	123	122	81	123	96	62	171	191	362
	32.3%	34.0%	33.7%	22.4%	34.0%	26.5%	17.1%	47.2%	52.8%	100%
Chi-square = 9.68, p < .05				Chi-square = 20.70, p < .01				Chi-square = 18.83, p < .001		
43. Most students understand mathematics better with the use of hands-on materials and manipulatives.										
SA/A	93	107	117							317
	29.3%	33.8%	36.9%							87.6%
Neutral	18	10	3							31
	58.1%	32.3%	9.7%							8.6%
SD/D	6	6	2							14
	42.9%	42.9%	14.3%							3.9%
Column Total	117	123	122							362
	32.3%	34.0%	33.7%							100%

Chi-square = 15.91, p < .01

a Awareness/Informational

Table 39b. Mathematics: Philosophy and Content Instruction Variables With Grade, SoC1, and SoCPN; N=362

	Grade			SoC 1				SoCPN		N
Variables	Sec	MS	Elem	AI^a	Self	Tasks	Impact	Pos	Neg	%
46. The best use of a textbook is as a resource rather than the primary instructional tool.										
SA/A	62 25.5%	82 33.7%	99 40.7%	53 21.8%	82 33.7%	57 23.5%	51 21.0%			243 67.1%
Neutral	16 37.2%	17 39.5%	10 23.3%	14 32.6%	15 34.9%	11 25.6%	3 7.0%			43 11.9%
SD/D	39 51.3%	24 31.6%	13 17.1%	14 18.4%	26 34.2%	28 36.8%	8 10.5%			76 21.0%
Column Total	117 32.3%	123 34.0%	122 33.7%	81 22.4%	123 34.0%	96 26.5%	62 17.1%			362 100%
Chi-square = 23.98, p < .001				Chi-square = 13.14, p < .05						
63. More mathematical power is gained from acquiring strong computational skills than from acquiring the ability to solve nonroutine (not familiar, more than one step) problems.										
SA/A								9 24.3%	28 75.7%	37 10.2%
Neutral								16 38.1%	26 61.9%	42 11.6%
SD/D								145 51.4%	137 48.6%	282 78.2%
Column Total								170 47.1%	191 52.9%	361 99.7%
								Chi-square = 11.35, p < .01		
67. Skill development should precede working on word problems rather than using the experience with word problems to develop the skills.										
SA/A	37 44.0%	27 32.1%	20 23.8%	23 27.4%	33 39.3%	22 26.2%	6 7.1%	25 29.8%	59 70.2%	84 23.2%
Neutral	31 44.9%	21 30.4%	17 24.6%	14 20.3%	25 36.2%	25 36.2%	5 7.2%	26 37.7%	43 62.3%	69 10.1%
SD/D	49 23.4%	75 35.9%	85 40.7%	44 21.1%	65 31.1%	49 23.4%	51 24.4%	120 57.4%	89 42.6%	209 57.7%
Column Total	117 32.3%	123 34.0%	122 33.7%	81 22.4%	123 34.0%	96 26.5%	62 17.1%	171 47.2%	191 52.8%	362 100%
Chi-square = 19.76, p < .001				Chi-square = 21.03, p < .01				Chi-square = 21.51, p < .001		
69. The overall goal of school mathematics is to increase students' computational skills.										
SA/A								17 30.9%	38 69.1%	55 15.2%
Neutral								15 45.5%	18 54.5%	33 9.1%
SD/D								139 50.7%	135 49.3%	274 75.7%
Column Total								171 47.2%	191 52.8%	362 100%
								Chi-square = 7.27, p < .05		

a Awareness/Informational

mathematics and a negative inclination toward the reform ($x^2 = 7.02$, $p < .05$). A strong relationship also exists between a positive attitude toward reform and agreement/strong agreement with the view that mathematics should "pump" rather than filter students into scientific/professional careers ($x^2 = 16.82$, $p < .001$). See Tables 40 and 41.

Teachers expressed beliefs that the school has a role in achieving these goals. Ninety-six percent agree/strongly agree that a goal of school mathematics is to equip students with the skills to become lifelong learners and to ensure that all students have an opportunity to become mathematically literate (96.1%). Teachers shared that a school mathematics program has a role in students becoming confident in their own abilities to do mathematics (96.1%) and to provide experiences to achieve this (98.6%) (Table 41).

Science

An aggregate view of the responses indicates a general consensus of agreement with the underlying NRC Standards philosophy. This would lead to a superficial conclusion that K-12 science teachers in Iowa are well on their way to implementing curriculum reform. A closer analysis of responses, however, reveals the topics with which teachers are not in agreement.

Tracking. Responses on the three questions in this category indicate that, in general, teachers do not agree that grouping students homogeneously fosters better learning than heterogeneous grouping. A majority of the teachers disagree/ strongly disagree that homogeneous groups foster better learning than heterogeneous (66.3%), that tracking by ability encourages science for all students (56.5%), and 63.8% agree/strongly agree that students learn more in heterogeneous grouped classes (Table 42).

Teachers who disagree/strongly disagree that homogeneous groups foster better learning and who agree/strongly agree that students learn more in heterogeneously grouped classes were more likely to be elementary teachers ($x^2 = 34.54$, $p < .001$ and ($x^2 = 14.85$, $p < .01$, respectively).

Table 40. Mathematics: Frequencies of Philosophy and Content Variables in Belief Category, N = 362.

Variables	Responses					
	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Missing
Beliefs						
33. Almost all children can learn to think mathematically.	135 37.3%	185 51.1%	11 3.0%	29 8.0%	2 0.6%	0 9%
44. The important goal of mathematics is to prepare students for further study of mathematics.	11 3.0%	85 23.5%	34 9.4%	192 53.0%	39 10.8%	1 0.3%
52. It is important that parents be involved in the mathematics education of their children.	165 45.6%	171 47.2%	18 5.0%	4 1.1%	4 1.1%	0 0%
53. Knowing mathematics is doing mathematics.	66 18.2%	167 46.1%	61 16.9%	62 17.1%	3 0.8%	3 0.8%
54. A goal of school mathematics is to equip students with the skills to become lifelong learners.	218 60.2%	130 35.9%	2 0.6%	3 0.8%	8 2.2%	1 0.3%
56. Mathematics should be a "pump" and not a filter that screens students out of scientific and professional careers.	61 16.9%	222 61.3%	55 15.2%	18 5.0%	3 0.8%	3 0.8%
58. A responsibility of a school mathematics program is to ensure that all students have an opportunity to become mathematically literate.	171 47.2%	177 48.9%	8 2.2%	4 1.1%	1 0.3%	1 0.3%
59. Learning to value mathematics is an important educational goal.	163 45.0%	184 50.8%	7 1.9%	6 1.7%	1 0.3%	1 0.3%
60. A school mathematics program has no role in students becoming confident in their own abilities to do mathematics.	2 0.6%	6 1.7%	5 1.4%	164 45.3%	184 50.8%	1 0.3%
62. A student who has gained mathematical power has the ability to use a variety of mathematical methods effectively to solve nonroutine problems.	135 37.3%	208 57.5%	14 3.9%	3 0.8%	2 0.6%	0 0%
64. A responsibility of school mathematics is to provide experiences that enable students to become confident in their own abilities to do mathematics.	164 45.3%	193 53.3%	4 1.1%	1 0.3%	0 0%	0 0%
65. Students who believe in the utility and value of mathematics are able to "mathematize" everyday events; that is, to acquire a mathematical perception of their world.	98 27.1%	214 59.1%	40 11.0%	8 2.2%	2 0.6%	0 0%

Table 41 Mathematics Philosophy and Content Belief Variables With Grade, SoC1, and SoCPN; N=362

	Grade			SoC 1				SoCPN		N %
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	
44. The most important goal of mathematics is to prepare students for further study of mathematics.										
SA/A								35 36.5%	61 63.5%	96 26.5%
Neutral								20 58.8%	14 41.2%	34 9.4%
SD/D								116 50.0%	116 50.0%	232 64.1%
Column Total								171 47.2%	191 52.8%	362 100%
								Chi-square = 7.02, $p < .05$		
52. It is important that parents be involved in the mathematics education of their children.										
SA/A	101 30.1%	117 34.8%	118 35.1%							336 92.8%
Neutral	14 77.8%	4 22.2%	0 0%							18 5.0%
SD/D	2 25.0%	2 25.0%	4 50.0%							8 2.2%
Column Total	117 32.3%	123 34.0%	122 33.7%							362 100%
Chi-square = 20.06, $p < .001$										
56. Mathematics should be a "pump" and not a filter that screens students out of scientific and professional careers.										
SA/A								148 51.7%	138 48.3%	286 79.0%
Neutral								12 21.8%	43 78.2%	55 15.2%
SD/D								11 52.4%	10 47.6%	21 5.8%
Column Total								171 47.2%	191 52.8%	362 100%
								Chi-square = 16.82, $p < .001$		
65. Students who believe in the utility and value of mathematics are able to "mathematize" everyday events; that is, to acquire a mathematical perception of their world.										
SA/A	91 29.2%	108 34.6%	113 36.2%							312 86.2%
Neutral	23 57.5%	11 27.5%	6 15.0%							40 11.0%
SD/D	3 30.0%	4 40.0%	3 30.0%							10 2.8%
Column Total	117 32.3%	123 34.0%	122 33.7%							362 100%

Chi-square = 14.24, $p < .01$

a Awareness/Informational

Table 42. Science: Frequencies of Philosophy and Content Variables in Tracking and Cooperative Group Categories; N = 329

	Responses					
Variables	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Missing
Tracking						
30. Homogeneous groups (students of similar abilities) foster better learning than heterogeneous groups.	18 5.5%	50 15.2%	42 12.8%	170 51.7%	48 14.6%	1 0.3%
33. Tracking by ability encourages science for all students.	12 3.6%	47 14.3%	84 25.5%	139 42.2%	47 14.3%	0 0%
43. Students learn more in heterogeneously grouped classes.	60 18.2%	150 45.6%	63 19.1%	50 15.2%	5 1.5%	1 0.3%
Cooperative Groups						
28. Cooperative learning groups are an effective instructional strategy in science.	152 46.2%	165 50.2%	8 2.4%	2 0.6%	2 0.6%	0 0%
44. Cooperative learning groups are a hindrance in science instruction.	0 0%	7 2.1%	19 5.8%	174 52.9%	129 39.2%	0 0%
52. It is more important for students to learn how to work independently rather than to work with others on solving problems.	2 0.6%	19 5.8%	41 12.5%	212 64.4%	54 16.4%	1 0.3%

Table 43. Science: Philosophy and Content Tracking Variables With Grade, SoC1, and SoCPN; N=329

	Grade			SoC 1				SoCPN		N %
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	
30. Homogeneous groups (students of similar abilities) foster better learning than heterogeneous groups.										
SA/A	40	21	7					31	37	68
	58.8%	30.9%	10.3%					45.6%	54.4%	20.7%
Neutral	11	18	13					23	19	42
	26.2%	42.9%	31.0%					54.8%	45.2%	12.8%
SD/D	59	65	94					136	82	218
	27.1%	29.8%	43.1%					62.4%	37.6%	66.5%
Column Total	110	104	114					190	139	328
	33.5%	31.7%	34.8%					57.9%	42.1%	99.7%
Chi-square = 34.54, p < .001								Chi-square = 6.20, p < .05		
33. Tracking by ability encourages science for all students.										
SA/A				16	20	20	3	30	29	59
				27.1%	33.9%	33.9%	5.1%	50.8%	49.2%	17.9%
Neutral				30	29	25	0	39	45	84
				35.7%	34.5%	29.8%	0%	46.4%	53.6%	25.5%
SD/D				44	57	61	24	122	64	186
				23.7%	30.6%	32.8%	12.9%	65.6%	34.4%	56.5%
Column Total				90	106	106	27	191	138	329
				27.4%	32.2%	32.2%	8.2%	58.1%	41.9%	100%
				Chi-square = 16.23, p < .05				Chi-square = 10.26, p < .01		
43. Students learn more in heterogeneously grouped classes.										
SA/A	58	65	87					138	72	210
	27.6%	31.0%	41.4%					65.7%	34.3%	64.0%
Neutral	25	22	16					26	37	63
	39.7%	34.9%	25.4%					41.3%	58.7%	19.2%
SD/D	27	17	11					27	28	55
	49.1%	30.9%	20.0%					49.1%	50.9%	16.8%
Column Total	110	104	114					191	137	328
	33.5%	31.7%	34.8%					58.2%	41.8%	99.7%
Chi-square = 14.85, p < .01								Chi-square = 14.18, p < .001		

[a] Awareness/Informational

In contrast, teachers who hold the opposite view with the statements were more likely to be secondary teachers. Middle school teachers reported mixed responses to the questions (Table 43).

An important observation is the relationship between responses on the questions and frequencies of positive or negative attitudes toward reform. Teachers who have expressed a positive view of the reform effort were more likely to disagree/strongly disagree that homogeneous groups foster better learning ($x^2 = 6.20$, $p < .05$), that tracking by ability encourages science for all students

($x^2 = 10.26$, $p < .01$), and to agree/strongly agree that students learn more in heterogeneously grouped classes ($x^2 = 14.18$, $p < .001$). See Table 43.

Cooperative Learning Groups A majority of the teachers expressed their support of the use of cooperative learning groups in instruction. Ninety-six percent agree/strongly agree that cooperative learning groups are an effective instructional strategy, 92.1% disagree/strongly disagree that they are a hindrance, and 80.1% disagree/strongly disagree that it is important for students to learn how to work independently rather than to work with others (Table 42). Elementary teachers were more likely to disagree/strongly disagree on the last question ($x^2 = 14.12$, $p < .01$) (Table 44).

Technology The appropriate use of computers is supported by a majority of teachers. Eighty-nine percent agree/strongly agree that computer technology is an important tool in the science laboratory and 61.1% disagree/strongly disagree that computers are best used as tools for writing or record keeping (Table 45). Teachers who agree/strongly agree on the importance of computers in laboratories were more likely to express a positive inclination toward the reform effort ($x^2 = 8.12$, $p < .05$). See Table 46.

Assessment A majority of teachers' views closely align philosophically with the NRC Standards on the alternative assessment issue. Seventy-seven percent of the teachers agree/strongly agree that open-ended projects are useful in assessing student performance, 87.9% agree/strongly agree that well-phrased questions encourage more open-ended investigations, 89.4% agree/strongly agree that a variety of alternative assessment strategies should be used, and 53.2% disagree/strongly disagree that evaluation is not an integral part of teaching/learning science (Table 45). The teachers who are positive toward reform were more likely to agree/strongly agree that open-ended projects are useful ($x^2 = 10.49$, $p < .01$) and that well-phrased questions encourage more open-ended investigations ($x^2 = 7.17$, $p < .05$) (Table 46).

Instruction Teachers were asked their beliefs on the role of application problems, the use of the textbook, and the effect of instructional strategies on student learning. Overall, teachers' views closely align with the underlying philosophy of the NRC Standards except for the effectiveness of

Table 44. Science: Philosophy and Content Cooperative Groups Variables With Grade, SoC1, and SoCPN; N=329

	Grade			SoC 1				SoCPN		N
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	%
52. It is more important for students to learn how to work independently rather than to work with others on solving problems.										
SA/A	10 47.6%	8 38.1%	3 14.3%							21 6.4%
Neutral	17 41.5%	18 43.9%	6 14.6%							41 12.5%
SD/D	83 31.2%	78 29.3%	105 39.5%							266 81.1%
Column Total	110 33.5%	104 31.7%	114 34.8%							328 99.7%

Chi-square = 14.12, $p < .01$

a Awareness/Informational

Table 45. Science: Frequencies of Philosophy and Content Variables in Techonology and Assessment Categories; N = 329

	Responses					
Variables	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Missing
Technology						
32. Computer technology is an important tool in the science laboratory.	111 33.7%	184 55.9%	29 8.8%	5 1.5%	0 0%	0 0%
46. Computers are best used by students as tools for writing or record keeping.	4 1.2%	37 11.2%	87 26.4%	180 54.7%	21 6.4%	0 0%
Assessment						
31. Open-ended projects are useful in assessing student performance.	72 21.9%	182 55.3%	57 17.3%	16 4.9%	1 0.3%	1 0.3%
41. Well-phrased questions encourage more open-ended investigations.	92 28.0%	197 59.9%	33 10.0%	7 2.1%	0 0%	0 0%
47. Instruction should use a variety of alternative assessment strategies (i.e., portfolios, authentic performance, etc.).	121 36.8%	173 52.6%	28 8.5%	5 1.5%	2 0.6%	0 0%
59. Although evaluation is important it is not an integral part of daily teaching and learning science.	14 4.3%	103 31.3%	36 10.9%	146 44.4%	29 8.8%	1 0.3%

Table 46. Science: Philosophy and Content Technology and Assessment Variables With Grade, SoC1, and SoCPN; N=329

	Grade			SoC 1				SoCPN		N
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	%
Technology										
32. Computer technology is an important tool in the science laboratory.										
SA/A								164 55.6%	131 44.4%	295 89.7%
Neutral								22 75.9%	7 24.1%	29 8.8%
SD/D								5 100%	0 0%	5 1.5%
Column Total								191 58.1%	138 41.9%	329 100%
								Chi-square = 8.12, p < .05		
Assessment										
31. Open-ended projects are useful in assessing student performance.										
SA/A								157 61.8%	97 38.2%	254 77.4%
Neutral								30 52.6%	27 47.4%	57 17.4%
SD/D								4 23.5%	13 76.5%	17 5.2%
Column Total								191 58.2%	137 41.8%	328 99.7%
								Chi-square = 10.49, p < .01		
41. Well-phrased questions encourage more open-ended investigations.										
SA/A								172 59.5%	117 40.5%	289 87.8%
Neutral								13 39.4%	20 60.6%	33 10.0%
SD/D								6 85.7%	1 14.3%	7 2.1%
Column Total								191 58.1%	138 41.9%	329 100%
								Chi-square = 7.17, p < .05		
47. Instruction should use a variety of alternative assessment strategies (i.e., portfolios, authentic performance, etc.).										
SA/A	88 29.9%	94 32.0%	112 38.1%							294 89.4%
Neutral	18 64.3%	9 32.1%	1 3.6%							28 8.5%
SD/D	4 57.1%	1 14.3%	2 28.6%							7 2.1%
Column Total	110 33.4%	104 31.6%	115 35.0%							329 100%

Chi-square = 19.71, p < .001

a Awareness/Informational

lecture presentation strategy. Seventy percent of the teachers agree/strongly agree that auditory presentations are effective. Secondary teachers were more likely to believe this than elementary teachers ($x^2 = 35.89$, $p < .001$).

Sixty-five percent of the teachers support the view that curriculum should not be organized around the textbook and that the textbook should be used as a resource (80.6%). Elementary teachers were more likely to hold these views ($x^2 = 16.43$, $p < .01$ and $x^2 = 10.18$, $p < .05$, respectively). See Tables 47 and 48.

Beliefs. Teachers expressed beliefs that philosophically align with the overall goals stated by NRC Standards. A majority of the teachers agree/strongly agree that almost all children can learn science (97.9%), that teaching thinking skills are important (98.9%), that parental involvement is important (87.6%), that learning science is an active process (99.1%), that science should be a pump and not a filter (76.3%), that learning to value science is important (96.6%), and that knowledge is actively constructed by a student through a process that is individual and social (86.1%). A majority of the teachers also believe that students must learn to take responsibility for their own learning (96.6%); a large number of teachers believe that students should have a significant voice in decisions about the content and context of their work (49.2%). Interesting is the observance that elementary teachers were more likely to agree with the last question and secondary teachers to disagree ($x^2 = 20.47$, $p < .001$). See Tables 49 and 50.

More than 56% of the teachers disagree/strongly disagree that preparing students for further study in science is the important goal of science instruction. Although 87.3% of the teachers agree/strongly agree that understanding concepts rather than vocabulary should be the main purpose of science teaching, 70.8% agree/strongly agree that science requires a knowledge of the terminology of each discipline. Secondary teachers were more likely to agree/strongly agree and elementary teachers to disagree/strongly disagree with this statement ($x^2 = 21.46$, $p < .001$).

Teachers believe that the school has a role in achieving these goals. Ninety-eight percent of the teachers agree/strongly agree that a goal of school science is to equip students with the skills to become lifelong learners and to ensure that all students have an opportunity to become scientifically literate (86.6%). Teachers also believe that a school science program has a role in students becoming confident in their own abilities to do science (97.3%) and to provide experiences to achieve this (96.9%).

Table 47. Science: Frequencies of Philosophy and Content Variables in Instruction Category; N = 329

	Responses					
Variables	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Missing
34. Science instruction should be tied to real-life applications.	166 50.5%	155 47.1%	5 1.5%	2 0.6%	1 0.3%	0 0%
37. Class instructions should not be include real-life applications.	4 1.2%	3 0.9%	4 1.2%	88 26.7%	230 69.9%	0 0%
38. Curriculum should be organized around the textbook.	2 0.6%	46 14.0%	67 20.4%	136 41.3%	78 23.7%	0 0%
39. Most students understand science better with the use of hands-on investigations.	199 60.5%	119 36.2%	8 2.4%	3 0.9%	0 0%	0 0%
42. The best use of a textbook is as a resource rather than the primary instructional tool.	117 35.6%	148 45.0%	34 10.3%	29 8.8%	1 0.3%	0 0%
45. Auditory presentations of information (lecture) is an effective instructional strategy.	10 3.0%	137 41.6%	44 13.4%	113 34.3%	25 7.6%	0 0%
54. Students learn "how to think" regardless of the instructional strategy used.	16 4.9%	30 9.1%	37 11.2%	202 61.4%	43 13.1%	1 0.3%

Table 48. Science: Philosophy and Content Instruction Variables With Grade, SoC1, and SoCPN, N=329

	Grade			SoC 1				SoCPN		N
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	%
38. Curriculum should be organized around the textbook.										
SA/A	24	12	12	10	18	18	2			48
	50.0%	25.0%	25.0%	20.8%	37.5%	37.5%	4.2%			14.6%
Neutral	30	21	16	26	18	22	1			67
	44.8%	31.3%	23.9%	38.8%	26.9%	32.8%	1.5%			20.4%
SD/D	56	71	87	54	70	66	24			214
	26.2%	33.2%	40.7%	25.2%	32.7%	30.8%	11.2%			65.0%
Column Total	110	104	115	90	106	106	27			329
	33.4%	31.6%	35.0%	27.4%	32.2%	32.2%	8.2%			100%
Chi-square = 16.43, p < .01				Chi-square = 12.88, p < .05						
42. The best use of a textbook is as a resource rather than the primary instructional tool.										
SA/A	78	87	100	69	85	86	25			265
	29.4%	32.8%	37.7%	26.0%	32.1%	32.5%	9.4%			80.5%
Neutral	17	9	8	16	11	6	1			34
	50.0%	26.5%	23.5%	47.1%	32.4%	17.6%	2.9%			10.3%
SD/D	15	8	7	5	10	14	1			30
	50.0%	26.7%	23.3%	16.7%	33.3%	46.7%	3.3%			9.1%
Column Total	110	104	115	90	106	106	27			329
	33.4%	31.6%	35.0%	27.4%	32.2%	32.2%	8.2%			100%
Chi-square = 10.18, p < .05				Chi-square = 12.95, p < .05						
45. Auditory presentations of information (lecture) is an effective instructional strategy.										
SA/A	64	55	28					72	75	147
	43.5%	37.4%	19.0%					49.0%	51.0%	44.7%
Neutral	12	17	15					27	17	44
	27.3%	38.6%	34.1%					61.4%	38.6%	13.4%
SD/D	34	32	72					92	46	138
	24.6%	23.2%	52.2%					66.7%	33.3%	41.9%
Column Total	110	104	115					191	138	329
	33.4%	31.6%	35.0%					58.1%	41.9%	100%
Chi-square = 35.89, p < .001								Chi-square = 9.37, p < .01		

[a] Awareness/Informational

Table 49. Science: Frequencies of Philosophy and Content Variables in Belief Category; N = 329

	Responses					
Variables	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Missing
Beliefs						
29. Almost all children can learn science.	226 68.7%	96 29.2%	1 0.3%	4 1.2%	2 0.6%	0 0%
35. Science requires a knowledge of the terminology of each discipline.	53 16.1%	180 54.7%	34 10.3%	51 15.5%	11 3.3%	0 0%
36. Teaching thinking skills is important in the science classroom.	231 70.2%	94 28.6%	1 0.3%	1 0.3%	1 0.3%	1 0.3%
40. The important goal of science instruction is to prepare students for further study of science.	16 4.9%	79 24.0%	48 14.6%	161 48.9%	25 7.6%	0 0%
48. It is important that parents be involved in the science education of their children.	92 28.0%	196 59.6%	35 10.6%	5 1.5%	1 0.3%	0 0%
49. Understanding concepts rather than vocabulary should be the main purpose of science teaching.	122 37.1%	165 50.2%	19 5.8%	23 7.0%	0 0%	0 0%
50. Learning science is an active process.	194 59.0%	132 40.1%	2 0.6%	0 0%	1 0.3%	0 0%
51. A goal of science education is to equip students with the skills to become lifelong learners.	220 66.9%	103 31.3%	4 1.2%	0 0%	0 0%	2 0.6%
53. Science should be a "pump" and not a filter that screens students out of scientific and professional careers.	75 22.8%	176 53.5%	61 18.5%	9 2.7%	6 1.8%	2 0.6%
55. A responsibility of a school science program is to ensure that all students have an opportunity to become scientifically literate.	101 30.7%	184 55.9%	18 5.5%	23 7.0%	2 0.6%	1 0.3%
56. Learning to value science is an important educational goal.	129 39.2%	189 57.4%	7 2.1%	2 0.6%	0 0%	2 0.6%
57. A school science program has no role in students becoming confident in their own abilities to do science.	1 0.3%	2 0.6%	6 1.8%	170 51.7%	150 45.6%	0 0%
58. A responsibility of school science is to provide experiences that enable students to become confident in their own abilities to do science.	132 40.1%	187 56.8%	7 2.1%	2 0.6%	1 0.3%	0 0%
60. Students must learn to take responsibility for their own learning.	159 48.3%	159 48.3%	6 1.8%	3 0.9%	1 0.3%	1 0.3%
61. Knowledge is actively constructed by a student through a process that is individual and social.	90 27.4%	193 58.7%	37 11.2%	6 1.8%	1 0.3%	2 0.6%
62. Students should have a significant voice in decisions about the content and context of their work.	24 7.3%	138 41.9%	75 22.8%	84 25.5%	6 1.8%	2 0.6%

Table 50 Science: Philosophy and Content Belief Variables With Grade, SoC1, and SoCPN; N=329

	Grade			SoC 1				SoCPN		N %
Variables	Sec	MS	Elem	AI[a]	Self	Tasks	Impact	Pos	Neg	
35. Science requires a knowledge of the terminology of each discipline.										
SA/A	94 40.3%	72 30.9%	67 28.8%							233 70.8%
Neutral	7 20.6%	9 26.5%	18 52.9%							34 10.3%
SD/D	9 14.5%	23 37.1%	30 48.4%							62 18.8%
Column Total	110 33.4%	104 31.6%	115 35.0%							329 100%
Chi-square = 21.46, p < .001										
62. Students should have a significant voice in decisions about the content and context of their work.										
SA/A	37 22.8%	54 33.3%	71 43.8%							162 49.5%
Neutral	30 40.0%	24 32.0%	21 28.0%							75 22.9%
SD/D	43 47.8%	26 28.9%	21 23.3%							90 27.5%
Column Total	110 33.6%	104 31.8%	113 34.6%							327 99.4%

Chi-square = 20.47, p < .001

a Awareness/Informational

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Evidence that curriculum reform is occurring in K-12 mathematics and science classrooms is as dependent on teachers' acceptance of, belief in, and dedication to the reform issues as on increased student conceptual understanding of mathematics and science. Both measures are necessary; however, the purpose of this research was to identify teachers' concerns and the factors, if any, that significantly relate to successful implementation of K-12 mathematics/science curriculum reform in Iowa. This is not to say that the concerns teachers expressed are indicative of what is happening in the classrooms. The data gathered for this study is significant in identifying the implementation status as based on expressed concerns and what teachers feel is important. Other valid questions important to the reform issue but not discussed within the scope of this study are (a) the success of classroom activities in raising student scores, (b) the reality of what actually happens in the classroom as opposed to what is reported as happening, and (c) whether or not what teachers feel to be important makes a difference in student achievement. These questions are important and should be addressed in further studies of implementation status.

The goals of the study were (1) to assess the progress that has been made in implementing mathematics/science curriculum reform using the concerns expressed by teachers and (2) to investigate the existence of significant relationships between expressed teacher concerns and demographic variables, participation in professional organization activities variables, and philosophical beliefs and content knowledge about curriculum reform issue variables. Teachers' concerns were identified using the Stages of Concern dimension of the Concerns-Based Adoption Model. Participation in a professional organization was measured by type of activity (from passive to active) and level of participation (from local to national). Philosophical belief and content knowledge about reform issues were measured by participants' responses on a Likert scale (of strongly agree to strongly disagree) to questions regarding philosophies and specific components of reform as stated by the National Council of Teachers of Mathematics (NCTM) Standards and/or the National Research Council (NRC) Standards.

Data were collected from a stratified random sample of 250 secondary and 250 middle school/junior high mathematics teachers, 250 secondary and 250 middle school/junior high science teachers, a set of 250 elementary teachers for each of mathematics and science, 179 mathematics teachers who participated in the model classroom project, and 179 science teachers who participated in the project. A survey instrument was developed and mailed to the mathematics teachers; a similar instrument was mailed to the science teachers. The overall return rate was 38.7%. Approximately one-third of the returned questionnaires were from each of the grade levels for each discipline. The return rate from teachers who participated in the demonstration classroom project was higher: 45.8% for mathematics, 62.6% for science.

Stages of Concern

Concerns-Based Adoption Model research indicates the effectiveness of the Stages of Concern Questionnaire to indicate implementation status through longitudinal studies of teachers' concerns. Change often requires an adjustment to one's belief system, a shift in a paradigm, that must be dealt with carefully in order to not alienate the key players in the change process, the teachers in the reform effort. Five or more years is normal for successful implementation to take place. With periodic studies of teachers' concerns, it is possible to track implementation progress and, more importantly, adjust interventions (inservices, workshop, etc.) to help teachers resolve the concerns that arise.

In a 1990 study of concerns secondary mathematics teachers have regarding implementation of the NCTM Standards, the vast majority of concerns centered on lack of awareness of, need for information on, and personal involvement with the innovation; validation of the existence of an initial period of implementation. The current study of mathematics teachers' concerns indicates a progression from the Awareness/Information/Self concerns to Self/Task/Impact concerns for the secondary teachers. Middle school and elementary teachers also expressed more Self, Task, or Impact concerns. A disconcerting observance of the study, though, is the preponderance of negative attitudes. In written statements, teachers expressed frustrations with a lack of resources and an insufficient amount of administrative support for expended time and effort. Many expressed a need for classroom materials, monetary support to attend workshops and conferences, collaboration time with colleagues, and verbal encouragement from principals, superintendents, school boards, and parents.

As expected for the initial years of reform, the science teachers' concerns were centered more on Awareness/Information, and Self. An encouraging observance is the large proportion of teachers with these concerns who expressed a positive inclination toward the effort. On the other hand, a trend similar to the one noted for mathematics teachers indicates that a majority of teachers with Task related concerns are frustrated with the lack of resources and support from administrators. Careful planning of appropriate implementation activities over the next five years is necessary to turn the tide of discontent that is present in the mathematics teachers and to thwart the potential tide with science teachers.

Demographic

Research reveals the existence of significant relationships between concerns expressed by mathematics and science teachers and demographic variables of years of experience, nature of college degree, professional development, and recency of experience. Awareness/Information or Self concerns are more likely related to the mathematics teachers who have five or less years ; Self or Task concerns for teachers who have taught six or more years. No discernible pattern was observed for science teachers.

A disparity in professional preparation, number of professional development hours, and recency of educational experience exists between secondary, middle school, and elementary teachers for both mathematics and science teachers. Secondary teachers reported more earned degrees in the discipline (mathematics/science) and/or discipline related education (mathematics/science education) as either a major or minor than did elementary teachers. A greater number of elementary teachers reported taking less than six hours of professional development activities and that the activities were a year or more ago. The number of hours related significantly with attitude toward the reform for mathematics teachers (fifteen or less hours related to negative attitudes and more than 35 hours related to positive attitudes) and with identified concerns for science teachers (less than six hours related to Awareness/Information concerns and more than 35 hours related to Self or Task concerns).

Professional Activity Participation

Secondary and middle school mathematics teachers reported almost twice as much participation in ICTM and/or NCTM activities such as memberships, reading journals, and conference attendance than did elementary teachers. Similarly, secondary and middle school science teachers reported almost three times as many memberships in state and/or national science/science education organizations and conferences attended than did elementary teachers. In addition, almost all science teachers reported reading journals at least occasionally; over 30% reported reading every month. Mathematics and science teachers engaged in informal discussions about the reform issues more often with colleagues, administrators, family/friends, and parents.

Leadership activities either as a member or as a chair were limited primarily to local and/or area committees and curriculum development projects for both mathematics and science teachers. An exception is the large number of secondary and middle school science teachers who worked on state and/or national level reform projects.

Participation in the demonstration classroom program as a visitor or as a teacher presented mixed results. Visitation in a demonstration classroom did not appear to relate significantly to teacher concerns or attitude toward reform. However, mathematics demonstration teachers expressed Task or Impact concerns and positive attitudes; science demonstration teachers expressed Self, Task, or Impact concerns but a significant relationship to attitude was not observed.

Consistent with the findings regarding the demographic variable regarding professional development, more mathematics and science elementary teachers than secondary or middle school teachers reported taking less than of six graduate courses. Conference presentations were almost the only Outreach activity in which teachers across the disciplines reported participation, science teachers primarily at the local and/or area level, mathematics at the local/area and ICTM/NCTM levels.

The current study has identified that the Passive activities of organization membership, reading journals, and attending conferences, Leadership activities of curriculum development member and demonstration classroom teacher, Instructional Advancement activities of demonstration classroom visitation and the number of graduate courses, and Outreach activities of conference presentations were significantly related to concerns expressed by mathematics and/or science teachers. Frequent participation and/or participation at the state/national levels related to higher concerns and positive attitudes. Strong relationships were also noted in the 1990 study between concerns of secondary mathematics teachers and reading journals, attending conferences, making presentations at conferences, and involvement in curriculum development.

Philosophy and Content Knowledge

Mathematics and science teachers do not agree that homogeneous grouping or tracking by ability fosters better learning. However, secondary mathematics teachers are more likely to see tracking as beneficial to student learning. A majority of the mathematics teachers believe it is important for students to learn to work independently and that cooperative learning groups are a means to achieving that goal; elementary science teachers are more likely to take the opposite view. The appropriate use of calculators and computers is supported by all teachers across grade levels. Elementary mathematics teachers are more likely than secondary teachers to disagree that calculators will inhibit learning basic computation skills.

A majority of teachers report views that closely align philosophically with the NCTM Standards and NRC Standards on the use of alternative assessment and instruction strategies such as the use of open-ended investigations, evaluation as part of instruction, the role of drill and application problems, and the use of the textbook. However, secondary mathematics teachers are more likely to believe that mastery of computation must be achieved before studying algebra and middle school teachers are more likely to believe that skill development should precede working on word problems rather than using application problems to develop skills. Secondary science teachers are more likely than middle school or elementary teachers to believe that lecture is an effective presentation mode. Most agree that a textbook should not determine the curriculum but should be used instead as a resource.

Teachers expressed agreement that almost all children can learn mathematics/science, that parental involvement is important, that knowing mathematics/science is doing mathematics/science, and that learning to value mathematics/science is important. Science teachers also believe that knowledge is actively constructed by a student through a process that is individual and social. Support was also expressed by mathematics teachers for the utilization of a variety of problem solving methods and the need for students to mathematize their world. Science teachers expressed the belief that students must learn to take responsibility for their own learning and have a significant voice in decisions about the content and context of their work. Although a majority of the science teachers agree that understanding concepts rather than vocabulary should be the main purpose of science teaching, elementary teachers are more likely to disagree with this. A majority of all teachers believe that the school has a role in helping students learn how to become lifelong learners, become confident in their own ability to do mathematics/science, become mathematically/scientifically literate, and to provide opportunities for students to achieve these goals.

In general, mathematics and science teachers expressed beliefs that closely align with the underlying philosophical tenets of the respective curriculum reform frameworks. As stated, teachers believe that tracking or grouping by ability does not benefit student learning, that cooperative learning groups and the appropriate use of calculators and computers do benefit student learning, that assessment is an integral part of instruction, and that application problems and problem solving are important. Most teachers were in agreement with the need for students to acquire skills to become life-long learners, to take responsibility for their own learning, to be given opportunities to gain confidence in their own abilities to do mathematics/science, and to become mathematically/scientifically literate. In addition to these beliefs, other beliefs for which a strong relationship was observed with mathematics and/or science teachers' concerns include disagreement that mastery of computation must come before studying algebra, that mathematical power is gained by acquiring strong computation skills, that curriculum should be organized around a textbook, that further study in mathematics/science is the important goal, and agreement that mathematics/science should be viewed as a pump and not a filter for scientific/professional careers. In all instances, teachers' whose beliefs align philosophically with the NCTM or NRC standards expressed concerns of Self, Task, or Impact and a positive attitude toward the reform effort.

Conclusions

Four overall conclusions emerge from this study. First, mathematics and science curriculum reform is being implemented in the K-12 school mathematics/science programs in Iowa. Change is a process that occurs over several years. The progression of concerns from those documented in the 1990 study (Awareness/Information or Self) to the concerns observed in this study (Self, Task, or Impact) is appropriate for the elapsed time between the introduction of the NCTM Standards six years ago. The Awareness/Information, Self or Task concerns expressed by the science teachers is a clear indication of an initial stage of implementation.

Second, a large number of mathematics teachers expressed negative attitudes toward the reform effort. A majority of these teaches also expressed Task related concerns. Frustration with the lack of resources and administrative support were cited as sources. An example of some of the written comments is, "I am asked to do more and more with less and less time, materials, and praise." At the time, a majority of the science teachers have positive attitudes toward the reform effort.

Third, teachers who actively participate in state and/or national mathematics or science organizations activities and whose philosophical views align closely with the NCTM and/or NRC standards are more successfully implementing curriculum reform and have positive attitudes toward the effort. Further analysis of data is needed to determine a causal effect between participation, philosophical alignment, and implementation status but the current analysis of data does show strong relationships exist between these variables and teacher concerns of and attitude toward mathematics and science curriculum reform.

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The fourth conclusion drawn from the data is that teachers who need the most help with mathematics/science (elementary teachers without a discipline or related education degree) are often the teachers who are least likely to engage in mathematics/science professional development hours and/or graduate courses. This is of special importance when teachers' concerns and attitudes toward reform issues are considered: teachers with six or less hours of professional development are more likely to express early concerns and a negative attitude.

Recommendations

Successful implementation of an innovation is more probable when appropriate intervention strategies are used to address the concerns of all persons affected by the the innovation. Change is personal and individual concerns vary; hence, different implementation strategies must be used to accommodate these differences. Change theory research shows that to impose intervention strategies that do not address the specific concerns of an individual can, in effect, stymie the individual at the current stage; i.e., inhibit resolution of the current concern and prevent arousal of higher concerns.

Recommendation #1

A survey of teachers' concerns needs to be made periodically on a three to five year basis so that adjustments can be made to the intervention strategies. There should be statewide surveys rather than random samples made to facilitate reporting of information regarding specific trends of concerns for individual school districts and/or Area Education Agencies. Dissimination of survey results to teachers, parents, school boards, and administrators is crucial to the program. Additionally, intervention strategies based on the examples presented in CBAM research that address the concerns need to be designed for each district or area.

Examples of interventions to facilitate change by addressing specific concerns are given in publications on the Concerns-Based Adoption Model (CBAM) such as the Hord, Rutherford, Huling-Austin, & Hall book, *Taking Charge of Change* (1987) and Gann's *Arithmetic Teacher* article, Making Change in Schools (1993). Additional assistance is available from the National's Regional Educational Laboratories publication, *Facilitating Systemic Change in Science and Mathematics Education: A Toolkit for Professional Developers* (1995). A copy of Gann's adaptation of the interventions from Hord et all (1987) is in Appendix C.

The current backlash to the reform effort from some teachers, administrators, school board members, and parents is due in part to the lack of information regarding the immediate need for reform. The demands of business and technology have placed on education to provide opportunities for students to learn how to problem solve in groups, to communicate and reason, and to connect understanding within and outside the discipline. These demands have necessitated mathematics/science programs to reach beyond basic facts and computational skills and to re-define basic skills to include those needed to meet the demands of business and technology. On the other hand, resistors to the reform call for programs that parallel those in which they were educated.

A first step in this process is to inform the public of the detrimental threat 'back-to-the-basics' programs are to students' career potentials by providing opportunities to increase their awareness of the need to reform. The public is cautious, and rightfully so, of new programs that cannot show evidence of student achievement. Dissemination of increased student achievement on standardized tests that measure basic facts and problem solving ability for students in new programs is needed. This implies, of course, that data of this nature is available and, if not, that it be gathered. A second step is to gather evidence of increased student achievement and to share the information with the public.

Garnering public support for mathematics/science reform programs requires time for the public to adjust a belief system of what these programs should look like and to gain a sense of ownership in the process and programs. This shift in paradigm is not unlike the shift society has undertaken toward the avoidance of secondhand smoke and the use of seat belts and air bags in automobiles. Teachers and administrators are important but they alone cannot counter strong parent and school board opposition. Wide-scale campaigns to inform the public of the need for new mathematics/science programs is needed.

Recommendation #2

Statewide marketing campaigns need to to funded to raise the public awareness of the need to reform mathematics/science school programs. The targeted audience is parents, teachers, administrators, school boards, and the general public. Television, radio, billboards, newspapers, magazines, and public meetings are examples of media avenues to be used. Funding for a professional, widespread marketing campaign needs to be allocated to impress upon the public the significance of the need.

The next two recommendations result from a relationship between the second and third conclusions cited in the previous section: the large number of negative attitudes expressed toward the reform and the significant relationship between the concerns/attitude and participation in professional organization activities. A relevant question is, "If teachers are permitted more opportunities to participate in organizational activities, would they feel less frustration and, hence, view the reform effort in a more positive light?" From written comments, teachers who expressed Task related concerns also expressed that they felt the time and effort they have been expending to implement reform has been unappreciated by the administration. They cited lack of praise, resources for necessary materials, trust in their professionalism to make curriculum decisions, collaboration time with colleagues, and support for conference attendance.

CBAM research shows that administrative support of a proposed change is important to implementation and that the building principal is the key change facilitator in a school. Examples of the ways that administration can give this support are to give private and public praise for a teacher's involvement in the reform effort, provide time for teachers to collaborate on curriculum planning on a long term and regular basis, provide time and resources for teachers to attend conferences and workshops initiated by state and national organizations, and provide time and resources for teachers to perform in leadership roles for the organizations. Hall and Hord, in *Change in Schools: Facilitating the Process* (1987), present an intervention taxonomy that consist of six game plan components that can be used to effect total change. The components suggest strategies to organize an intervention plan that will provide for developing a supportive organizational arrangement, training, providing consultation and reinforcement, monitoring and evaluation, external communication, and dissemination. A copy of the intervention plan taken from Hord et al. (1987) is in Appendix D.

Recommendation #3

A periodic survey of concerns of administrators, school boards, and parents and an intervention plan that addresses their concerns need to be made in order to successfully implement mathematics and science curriculum reform. Resources and training of a change facilitator in each school or Area Education Agency to work with these groups is necessary.

Teachers who actively participate in state and national organizations are more open and receptive to innovations. In addition to opportunities to hear state and national leaders in mathematics and science education, conferences allow teachers to interact in informal 'hallway' conversations. These informal interactions are many times are as important (if not more so in some cases) as the formal conference program addresses. Collegial support, shared classroom ideas, and inspiration for new ideas are often the incidental gems that teachers gain from these encounters. When school district policy limits attendance at conferences and discourages leadership involvement, the teachers are closed out of collaboration time with colleagues across district and/or state boundaries. The district gains much from the small investment needed to send a teacher to conferences and workshops outside the district.

Recommendation #4

An appeal needs to be made to administrators and school boards of the importance their support of teacher attendance at state and national level conferences and of teacher involvement in organizational leadership roles has on a school district's adaptiveness and implementation of innovative programs.

The fifth recommendation is to reiterate a need for more mathematics content in teacher preparation program (K-12) but to emphasize the relevance of the need for the elementary education preservice and inservice programs. National education leaders have called for more discipline content in secondary education preparatory programs of study but the elementary education major's multi-disciplined program leaves little room for in-depth study of the subjects. The elementary education teacher, typically a math-avoider, is not likely to voluntarily take more than the required one or two mathematics content courses. A proactive, aggressive state mandate would place the emphasis on the need beyond mere lip-service. To best garner grassroots ownership, a consensus of post-secondary education and discipline faculty and K-12 classroom teachers would set the minimum requirements.

Recommendation #5

Teacher education preservice programs of study need to include sufficient mathematics/science content experiences for all elementary, middle school, and secondary mathematics/science education majors. Evidence of such experiences would include tasks listed in NCTM and/or NRC mathematics/science curriculum reform statements. Students would be assessed on mathematical/scientific content as well as on pedagogy and assessment/evaluation strategies consistent with the reform focus. The number of hours would depend on the course descriptions and requirements as stated by the post-secondary institution.

These are general recommendations. Specific recommendations can be made only after individual, district, or AEA concerns are identified. However, the recommendations do give some direction for the continued planning for successful implementation. A major problem with the format of research of this nature (data gathering, analysis thereof, conclusions drawn and recommendations made) is that unless something is done, the study is just a nice activity that was completed. Dissemination of the results, conclusions, and recommendations to school boards, administrators, teachers, and parents is necessary. Adherence to suggested CBAM plans and strategies of specific plans for inservicing members of school boards, administration, parents and teachers on an on-going basis is highly recommended and key to successful implementation.

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Appendix A

Survey Instruments

INSTRUCTIONS FOR COMPLETING THE SURVEY

For the Questionnaire:

- Use the enclosed computer answer sheet or the Open-Ended Response Sheet to record your responses to the questionnaire items.
- Please do not enter your name on the answer sheet.
- **Record all of your responses on the Computer Answer Sheet as indicated below.** An Open-Ended Response Sheet is provided for responses marked "Other". Follow the directions for marking the answer sheets.

  Using the rating scale indicated for each item, please blacken in the corresponding number on your computer answer sheet which most accurately answers each item. Use a No. 2 pencil.

IMPORTANT DIRECTIONS FOR MARKING ANSWERS

- Use black lead pencil only (No. 2)
- Do NOT use ink or ballpoint pens.
- Make heavy black marks that fill the circle completely as shown:
  Ex. 1 2 3 4 5 6 7 8
- Erase cleanly any answer you wish to change.
- Make no stray marks on the answer sheet.

- Complete the DATE OF BIRTH and SEX sections on the answer sheet. Indicate the grade levels you currently teach in the GRADE OR EDUC section. **Darken all circles that apply.**
- Do not complete the IDENTIFICATION NUMBER or the SPECIAL CODE sections.

When you are finished:

- This survey should take approximately 30 minutes of your time to complete.
- PLEASE DO NOT FOLD the **Computer Answer Sheet.**
- Place the UNFOLDED **Computer Answer Sheet** and **Open-Ended Response Sheet** in the addressed, stamped envelope provided, seal it, and mail it to the address on the envelope.

DEMOGRAPHIC INFORMATION

Please record on the answer sheet the requested information.

1. Which best describes you? **Darken one circle.**
   (1) American Indian or Alaskan Native
   (2) Asian or Pacific Islander
   (3) Hispanic, regardless of race
   (4) African-American
   (5) White (not of Hispanic origin)
   (6) Prefer not to answer

2. How many years have you taught at either the elementary or secondary level prior to this school year? **Darken one circle.**
   (1) Fewer than three years
   (2) 3 - 5 years
   (3) 6 - 10 years
   (4) 11-15 years
   (5) 16 - 20 years
   (6) More than 20 years

3. What is the total number of mathematics classes you teach each day? **Darken one circle.**
   (1) 1
   (2) 2
   (3) 3
   (4) 4
   (5) 5
   (6) 6
   (7) More than 6

4. How many different subject preparations do you make each day?
   (1) 1
   (2) 2
   (3) 3
   (4) 4
   (5) 5
   (6) More than 5

5. Do you have a major or minor in mathematics at the undergraduate or graduate level? **Darken one circle.**
   (1) Yes
   (2) No

6. Do you have a major or minor in mathematics education at the undergraduate or graduate level? **Darken one circle.**
   (1) Yes
   (2) No

7. During the *last twelve months*, what is the *total* amount of time you have spent on professional development in mathematics or the teaching of mathematics? Include attendance at professional meetings and conferences, workshops, and courses. **Darken one circle.**
   (1) None
   (2) Less than 6 hours
   (3) 6 - 15 hours
   (4) 16 - 35 hours
   (5) More than 35 hours

8. When was your most recent course or in-service education experience in mathematics or mathematics teaching? **Darken one circle.**
   (1) Within the last 3 months
   (2) 3 - 6 months ago
   (3) 7 -12 months ago
   (4) 1 - 3 years ago
   (5) More than 3 years ago

PROFESSIONAL ACTIVITY PARTICIPATION

Respond to the following questions based upon your participation within **the past 5 years**
Mark ALL of the following activities in which you participate:

9. Paid member of the following mathematics education organizations:
    - (1) Iowa Council of Teachers of Mathematics (ICTM)
    - (2) National Council of Teachers of Mathematics (NCTM)
    - (3) National Council of Supervisors of Mathematics (NCSM)
    - (4) School Science and Mathematics Association
    - (5) Mathematical Association of America (MAA)
    - (6) Other (List any other organizations on the Open-Ended Response Sheet)
    - (7) None

10. Professional mathematics education journals you read some or all of on a monthly or regular basis.
    - (1) ICTM Journal
    - (2) Arithmetic Teacher and/or Mathematics Teacher
    - (3) Journal for Research in Mathematics Education
    - (4) School Science and Mathematics
    - (5) Other (List any other publications on the Open-Ended Response Sheet)
    - (6) None

11. Attended the following mathematics or mathematics education conferences:
    - (1) UNI Fall Mathematics Conference
    - (2) ICTM Mathematics Conference
    - (3) NCTM Regional
    - (4) NCTM National Conference
    - (5) Iowa MAA Sectional Meeting
    - (6) Iowa Mathematics and Science Coalition (IMSC) Governor's Conference
    - (7) Other (List any other meetings on the Open-Ended Response Sheet)
    - (8) None

12. Contributed articles for reviewed to the following mathematics education publications:
    - (1) ICTM Journal
    - (2) Arithmetic Teacher and/or Mathematics Teacher
    - (3) School Science and Mathematics
    - (4) Journal for Research in Mathematics Education
    - (5) Other (List any other publications on the Open-Ended Response Sheet)
    - (6) None

13. Published an article in a professional mathematics education journal.
    - (1) ICTM Journal
    - (2) Arithmetic Teacher and/or Mathematics Teacher
    - (3) School Science and Mathematics
    - (4) Journal for Research in Mathematics Education
    - (5) Other (List any other publications on the Open-Ended Response Sheet)
    - (6) None

14. Made a presentation at a conference or workshop on mathematics education.
    - (1) UNI Fall Mathematics Conference
    - (2) ICTM Mathematics Conference
    - (3) NCTM Regional
    - (4) NCTM National Conference
    - (5) Iowa MAA Sectional Meeting
    - (6) Local or AEA
    - (7) IMSC Governor's Conference
    - (8) Other (List any other meetings on the Open-Ended Response Sheet)
    - (9) None

15. **Committee member** of a mathematics education organization at the indicated level:
(1) Local school district
(2) AEA
(3) State (regional)
(4) State
(5) National (regional)
(6) National
(7) Other (List any other levels on the Open-Ended Response Sheet)
(8) None

16. **Committee chairperson** of a mathematics education organization at the indicated level:
(1) Local school district
(2) AEA
(3) State (regional)
(4) State
(5) National (regional)
(6) National
(7) Other (List any other levels on the Open-Ended Response Sheet)
(8) None

17. Discuss mathematics education reform issues **informally** with the indicated groups:
(1) Parents
(2) Business community
(3) Legislative representatives
(4) Students
(5) Administrators
(6) Family and friends
(7) Other (List any others on the Open-Ended Response Sheet)
(8) None

18. Discuss mathematics education reform issues **formally** with the indicated groups:
(1) Parents
(2) Business community
(3) Legislative representatives
(4) Students
(5) Administrators
(6) Family and friends
(7) Other (List any others on the Open-Ended Response Sheet)
(8) None

19. Participated in professional development workshops or courses in mathematics or the teaching of mathematics at the indicated level:
(1) Local school district
(2) AEA
(3) State
(4) National
(5) Other (List any other levels on the Open-Ended Response Sheet)
(6) None

20. Enrolled in graduate level courses or professional development courses in mathematics or the teaching of mathematics:
(1) One semester or quarter course
(2) 2-5 semester or quarter courses
(3) 6-10 semester or quarter courses
(4) More than 10 semester or quarter courses
(5) Other (List any others on the Open-Ended Response Sheet)
(6) None

21. Participated as a **committee member** in planning a conference at the indicated level:
(1) Local school district
(2) AEA
(3) State (regional)
(4) State
(5) National (regional)
(6) National
(7) Other (List any other levels on the Open-Ended Response Sheet)
(8) None

22. Participated as **committee chairperson** in planning a conference at the indicated level:
(1) Local school district
(2) AEA
(3) State (regional)
(4) State
(5) National (regional)
(6) National
(7) Other (List any other levels on the Open-Ended Response Sheet)
(8) None

23. Participated as a committee member in curriculum development at the indicated level:
(1) Local school district (2) AEA
(3) State (regional) (4) State
(5) National (regional) (6) National
(7) Other (List any other levels on the Open-Ended Response Sheet)
(8) None

24. Participated as a committee chairperson in *curriculum development* at the indicated level:
(1) Local school district (2) AEA
(3) State (regional) (4) State
(5) National (regional) (6) National
(7) Other (List any other levels on the Open-Ended Response Sheet)
(8) None

25. Participated as an Executive Board or Governing Board member at the indicated level:
(1) ICTM (2) NCTM (3) IMSC
(4) Other (List any other levels on the Open-Ended Response Sheet)
(5) None

26. Served as an editor of journal for the indicated mathematics education journals:
(1) ICTM Journal
(2) Arithmetic Teacher and/or Mathematics Teacher
(3) School Science and Mathematics
(4) Journal for Research in Mathematics Education
(5) Other (List any other publications on the Open-Ended Response Sheet)
(6) None

27. Served as an editor of newsletter for the indicated mathematics organizations:
(1) Iowa Council of Teachers of Mathematics (ICTM)
(2) National Council of Teachers of Mathematics (NCTM)
(3) National Council of Supervisors of Mathematics (NCSM)
(4) School Science and Mathematics Association
(5) Mathematical Association of America (MAA)
(6) Other (List any other organizations on the Open-Ended Response Sheet)
(7) None

28. Participated in the New Standards Project to pilot the use of portfolios as assessment:
(1) Yes (2) No

29. Served on a North Central Site Visitation Team for mathematics:
(1) Yes (2) No

30. Participated in demonstration/model classroom:
(1) As a demonstration teacher
(2) As a visitor to a demonstration site
(3) I have not participated.

31. Participated in the Presidential Awardee for Excellence in Mathematics Teaching:
(1) As a state awardee
(2) As a state finalist (i.e., attended the ceremony in Washington, D.C. with other state finalist)
(3) I have not been named an awardee but I have completed the application process at least once.
(4) I have not participated.

PHILOSOPHY and CONTENT

Please respond to each of the following items as you understand and have an opinion at this time using the indicated scale. Respond according to the strength of your agreement with each of the following statements. Begin each statement with the phrase, "I believe that . . .".

Darken one circle for each item.

1 - Strongly agree	2 - Agree	3 - No Opinion	4 - Disagree	5 - Strongly Disagree

32. Students learn more by working on "drill" problems in class.

33. Almost all children can learn to think mathematically.

34. Homogeneous groups (students of similar abilities) foster better learning than heterogeneous groups.

35. Learning to perform complex computations with speed and accuracy is important for most students.

36. Calculator use will inhibit learning basic computation skills.

37. Tracking by ability encourages mathematics for all students.

38. It is important that students first master computation skills before studying algebra.

39. Calculators should be available to students at all times even when practicing basic computation skills.

40. Calculators should be available to use at all times except when practicing basic computation skills.

41. Class instructions should not be disrupted by including real-life applications.

42. Curriculum should be organized around the textbook.

43. Most students understand mathematics better with the use of hands-on materials and manipulatives.

44. The important goal of mathematics instructions is to prepare students for further study of mathematics.

45. Well-phrased questions encourage more open-ended investigations.

46. The best use of a textbook is as a resource rather than the primary instructional tool.

47. Students learn more in heterogeneously grouped classes.

48. Cooperative learning groups are a hindrance in mathematics instruction.

49. Calculators should be an integral tool in mathematics instruction.

50. Computers are best used by students as tools for writing or record keeping.

51. Instruction should use a variety of alternative assessment strategies.

52. It is important that parents be involved in the mathematics education of their children.

1 - Strongly agree	2 - Agree	3 - No Opinion	4 - Disagree	5 - Strongly Disagree

53. Knowing mathematics is doing mathematics.

54. A goal of school mathematics is to equip students with the skills to become lifelong learners.

55. It is more important for students to learn how to work independently rather than to work with others on solving problems.

56. Mathematics should be a "pump" and not a filter that screens students out of scientific and professional careers.

57. Students learn "how to think" regardless of the instructional strategy used.

58. A responsibility of a school mathematics program is to ensure that all students have an opportunity to become mathematically literate.

59. Learning to value mathematics is an important educational goal.

60. A school mathematics program has no role in students becoming confident in their own abilities to do mathematics.

61. Skills needed for the 21st century are acquired by working independently to solve explicit sets of drill and practice exercises.

62. A student who has gained mathematical power has the ability to use a variety of mathematical methods effectively to solve nonroutine problems.

63. More mathematical power is gained from acquiring strong computational skills than from acquiring the ability to solve nonroutine (not familiar, more than one step) problems.

64. A responsibility of school mathematics is to provide experiences that enable students to become confident in their own abilities to do mathematics.

65. Students who believe in the utility and value of mathematics are able to "mathematize" everyday events; that is, to acquire a mathematical perception of their world.

66. The use of a calculator reduces the need for estimation and approximation skills.

67. Skill development should precede working on word problems rather than using the experience with word problems to develop the skills.

68. Although evaluation is important it is not an integral part of daily teaching and learning mathematics.

69. The overall goal of school mathematics is to increase students' computational skills.

70. It is more important for students to learn one method rather than a variety of methods to solve nonroutine (not familiar, more than one step) problems.

STAGES of CONCERNS QUESTIONNAIRE
Introduction

The purpose of this questionnaire is to determine what people who are using or thinking about using various programs are concerned about at various times during the innovation adoption process. The items were developed from typical responses of school and college teachers who ranged from no knowledge at all about various programs to many years experience in using them. Therefore, a good part of the items on this questionnaire may appear to be of little relevance or irrelevant to you at this time. For the completely irrelevant items, mark "1" on the computer answer sheet. Other items will represent those concerns you do have, in varying degrees of intensity, and should be marked higher.

For example:

This statement is very true of me at this time	1	2	3	4	5	6	7	8
This statement is somewhat true of me now.	1	2	3	4	5	6	7	8
This statement is not at all true of me at this time.	1	2	3	4	5	6	7	8
This statement seems irrelevant to me.	1	2	3	4	5	6	7	8

Please respond to the items in terms of *your present concerns* or how you feel about your involvement or potential involvement with the **mathematics curriculum reform**. A summary definition of this is given below. Remember to respond to each item in terms of *your present concerns* about your involvement or potential involvement with the **mathematics curriculum reform**.

Definition: Mathematics Curriculum Reform

The National Council of Teachers of Mathematics (NCTM) has directed national curriculum reforms focusing on all aspects of school mathematics. In the *Curriculum and Evaluation Standards for School Mathematics* (NCTM, 1989) and *Professional Standards for Teaching Mathematics* (NCTM, 1991), the NCTM has defined teaching and assessment strategies that promote conceptual learning in all students. Basic philosophical premises of the curriculum reform include the following:

- students learn more when they are actively engaged in the learning process,
- assessment is a part of instruction,
- students need to become problem solvers,
- students need to reason and communicate mathematically,
- students need to value and see the usefulness of mathematics, and
- students need to become confident in their own ability to do mathematics.

Instructional practices that support and encourage this philosophical shift in what it means to learn mathematics include material and instructional reform through the use of the some or all of the following:

- effective questioning techniques (i.e., asking "Why?", "How do you know . .?", and "What if . ?"),
- hands-on materials and/or manipulatives,
- the constructivist view of learning (i.e., encourage students to construct their own meaning of the concepts),
- cooperative learning groups or other strategy that fosters learning by student-to-student discussion ,
- portfolios as an assessment tool for student growth and understanding,
- projects and open-ended assessment items that have more than one correct response or that require a written response, and
- technology that encourages discovery of generalizations.

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MATHEMATICS CURRICULUM REFORM
Stages of Concern Questionnaire–Items

1	2	3	4	5	6	7	8
Irrelevant	Not true of me now		Somewhat true of me now			Very true of me now	

71. I am concerned about students' attitudes toward this mathematics curriculum reform. 1 2 3 4 5 6 7 8

72. I now know of some other approaches that might work better. 1 2 3 4 5 6 7 8

73. I don't even know what the mathematics curriculum reform is. 1 2 3 4 5 6 7 8

74. I am concerned about not having enough time to organize myself each day. 1 2 3 4 5 6 7 8

75. I would like to help other faculty in their use of the mathematics curriculum reform. 1 2 3 4 5 6 7 8

76. I have a very limited knowledge about the mathematics curriculum reform. 1 2 3 4 5 6 7 8

77. I would like to know the effect of reorganization on my professional status. 1 2 3 4 5 6 7 8

78. I am concerned about conflict between my interests and my responsibilities. 1 2 3 4 5 6 7 8

79. I am concerned about revising my use of the mathematics curriculum reform. 1 2 3 4 5 6 7 8

80. I would like to develop working relationships with both our faculty and outside faculty using this mathematics curriculum reform. 1 2 3 4 5 6 7 8

81. I am concerned about how the mathematics curriculum reform affects students. 1 2 3 4 5 6 7 8

82. I am not concerned about this mathematics curriculum reform. 1 2 3 4 5 6 7 8

83. I would like to know who will make the decisions in the mathematics curriculum reform system. 1 2 3 4 5 6 7 8

84. I would like to discuss the possibility of using the mathematics curriculum reform. 1 2 3 4 5 6 7 8

85. I would like to know what resources are available if we decide to adopt this mathematics curriculum reform. 1 2 3 4 5 6 7 8

86. I am concerned about my inability to manage all the mathematics curriculum reform requires. 1 2 3 4 5 6 7 8

87. I would like to know how my teaching or administration is supposed to change. 1 2 3 4 5 6 7 8

88. I would like to familiarize other departments or persons with the progress of this mathematics curriculum reform. 1 2 3 4 5 6 7 8

89. I am concerned about evaluating my impact on students. 1 2 3 4 5 6 7 8

90. I would like to revise the mathematics curriculum reform's instructional approach. 1 2 3 4 5 6 7 8

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MATHEMATICS CURRICULUM REFORM
Stages of Concern Questionnaire - Items

1	2	3	4	5	6	7	8
Irrelevant	Not true of me now		Somewhat true of me now			Very true of me now	

91. I am completely occupied with other things. 1 2 3 4 5 6 7 8

92. I would like to modify our use of the mathematics curriculum reform based on the experiences of our students. 1 2 3 4 5 6 7 8

93. Although I don't know about this mathematics curriculum reform, I am concerned about things in the area. 1 2 3 4 5 6 7 8

94. I would like to excite my students about their part in this mathematics curriculum reform. 1 2 3 4 5 6 7 8

95. I am concerned about time spent working with nonacademic problems related to this mathematics curriculum reform. 1 2 3 4 5 6 7 8

96. I would like to know what the use of the mathematics curriculum reform will require in the immediate future. 1 2 3 4 5 6 7 8

97. I would like to coordinate my effort with others to maximize the mathematics curriculum reform's effects. 1 2 3 4 5 6 7 8

98. I would like to have more information on time and energy commitments required by this mathematics curriculum reform. 1 2 3 4 5 6 7 8

99. I would like to know what other faculty are doing in this area. 1 2 3 4 5 6 7 8

100. At this time, I am not interested in learning about this mathematics curriculum reform. 1 2 3 4 5 6 7 8

101. I would like to determine how to supplement, enhance, or replace the mathematics curriculum reform. 1 2 3 4 5 6 7 8

102. I would like to use feedback from students to change the mathematics curriculum reform. 1 2 3 4 5 6 7 8

103. I would like to know how my role will change when I am using the mathematics curriculum reform. 1 2 3 4 5 6 7 8

104. Coordination of tasks and people is taking too much of my time. 1 2 3 4 5 6 7 8

105. I would like to know how this mathematics curriculum reform is better than what we have now. 1 2 3 4 5 6 7 8

106. Please write one or two paragraphs on the Open-Ended Response Sheet for the following:
When I think about my involvement with the mathematics curriculum refom I am concerned about: ____

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DEMOGRAPHIC INFORMATION

Please record on the answer sheet the requested information:

1. Which best describes you? **Darken one circle.**
   (1) American Indian or Alaskan Native
   (2) Asian or Pacific Islander
   (3) Hispanic, regardless of race
   (4) White (not of Hispanic origin)
   (5) Prefer not to answer

2. How many years have you taught at either the elementary or secondary level prior to this school year? **Darken one circle.**
   (1) Fewer than three years
   (2) 3 - 5 years
   (3) 6 - 10 years
   (4) 11-15 years
   (5) 16 - 20 years
   (6) More than 20 years

3. What is the total number of science classes you teach each day? **Darken one circle**
   (1) 1
   (2) 2
   (3) 3
   (4) 4
   (5) 5
   (6) 6
   (7) More than 6

4. How many different subject preparations do you make each day?
   (1) 1
   (2) 2
   (3) 3
   (4) 4
   (5) 5
   (6) More than 5

5. Do you have a major or minor in science at the undergraduate or graduate level?
   (1) Yes
   (2) No

6. Do you have a major or minor in science education at the undergraduate or graduate level?
   (1) Yes
   (2) No

7. During the *last twelve months,* what is the *total* amount of time you have spent on professional development in science or the teaching of science? Include attendance at professional meetings and conferences, workshops, and courses. **Darken one circle.**
   (1) None
   (2) Less than 6 hours
   (3) 6 - 15 hours
   (4) 16 - 35 hours
   (5) More than 35 hours

8. When was your most recent course or in-service experience in science teaching?
   (1) Within the last 3 months
   (2) 3 - 6 months ago
   (3) 7 -12 months ago
   (4) 1 - 3 years ago
   (5) More than 3 years ago

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PROFESSIONAL ACTIVITY PARTICIPATION

Respond to the following questions based upon your participation within the past 5 years
Mark All of the following activities in which you participate:

9. Science education organizations of which you have been or presently are a paid member:
   (1) Iowa Science Teachers Section of the Iowa Academy of Science
   (2) Elementary Science Teachers Section of the Iowa Academy of Science
   (3) National Science Teachers Association
   (4) School Science and Mathematics Association
   (5) American Association for the Advancement of Science
   (6) Other (List other general science education organizations on the Open-Ended Response Sheet)
   (7) None

10. Science discipline organizations of which you have been or presently are a paid member:
   (1) American Association of Physics Teachers (AAPT)
   (2) National Association of Biology Teachers (NABT)
   (3) National Earth Science Teachers Association (NESTA)
   (4) American Chemical Society (ACS)
   (5) Other (List other discipline or grade specific science organizations on the Open-Ended Response Sheet)
   (6) None

11. I read professional science education journals/magazines.
   (1) Every month
   (2) Several times a year
   (3) Occasionally
   (4) Never

12. Attended the following science and/or science education conferences:
   (1) Iowa Science Teachers Fall Conference
   (2) Iowa Academy of Science Spring Meeting
   (3) NSTA Regional Convention
   (4) NSTA National Convention
   (5) Other (List any other meetings on the Open-Ended Response Sheet)
   (6) None

13. Published an article in a professional science education journal:
   (1) Iowa Science Teachers Journal
   (2) The Science Teacher/Science Scope/Science and Children
   (3) School Science and Mathematics
   (4) Other (List any other publications on the Open-Ended Response Sheet)
   (5) None

14. Made a presentation at a conference or workshop on science education:
   (1) Iowa Science Teachers Fall Conference
   (2) Iowa Academy of Science Spring Meeting
   (3) NSTA Regional Convention
   (4) NSTA National Convention
   (6) Local or AEA science curriculum meetings or inservices
   (7) Other (List any other meetings on the Open-Ended Response Sheet)
   (8) None

15. Participated in science curriculum writing at the local level
    (1) Every year (ongoing process)
    (2) Every few years
    (3) Infrequently
    (4) I have not participated

16. Participated in the development of a curriculum project on a statewide or national level:
    (1) As a writer
    (2) As a field tester
    (3) Adopting at the local level
    (4) No involvement

17. Participated in a science education reform project:
    (1) Scope, Sequence, and Coordination Project
    (2) Project 2061
    (3) New Standards Project
    (4) Chataugua Science/Technology/Society
    (5) Other (List any other meetings on the Open-Ended Response Sheet)
    (6) I have not participated

18. Participated in demonstration/model classrooms:
    (1) As a demonstration teacher
    (2) As a visitor to a demonstration site
    (3) I have not participated

19. **Committee member** of a science education organization at the indicated level:
    (1) Local school district
    (2) AEA
    (3) State
    (4) Regional
    (5) National
    (6) Other (List any other levels on the Open-Ended Response Sheet)
    (7) None

20. **Committee chairperson** of a science education organization at the indicated level:
    (1) Local school district
    (2) AEA
    (3) State
    (4) Regional
    (5) National
    (6) Other (List any other levels on the Open-Ended Response Sheet)
    (7) None

21. **Executive committee member** of a science education organization at the indicated level:
    (1) Local school district
    (2) AEA
    (3) State
    (4) Regional
    (5) National
    (6) Other (List any other levels on the Open-Ended Response Sheet)
    (7) None

22. **Regional director** of a science education organization at the indicated level:
(1) AEA
(2) State
(3) National
(4) None

23. **Elected officer** of a science education organization at the indicated level:
(1) Local school district
(2) AEA
(3) State
(4) Regional
(5) National
(6) Other (List any other levels on the Open-Ended Response Sheet)
(7) None

24. Discuss science education reform issues **informally** with the indicated groups:
(1) Parents
(2) Business community
(3) Legislative representatives
(4) Students
(5) Colleagues
(6) Administrators
(7) Family and friends
(8) Other (List any others on the Open-Ended Response Sheet)
(9) None

25. Discuss science education reform issues **formally** with the indicated groups:
(1) Parents
(2) Business community
(3) Legislative representatives
(4) Students
(5) Colleagues
(6) Administrators
(7) Family and friends
(8) Other (List any others on the Open-Ended Response Sheet)
(9) None

26. Participated in professional development workshops or courses in science or the teaching of science at the indicated level:
(1) Local school district
(2) AEA
(3) State
(4) National
(5) Other (List any other levels on the Open-Ended Response Sheet)

27. Enrolled in graduate level courses or professional development courses in science or the teaching of science:
(1) One semester or quarter course
(2) 2-5 semester or quarter courses
(3) 6-10 semester or quarter courses
(4) More than 10 semester or quarter courses
(5) Other (List any others on the Open-Ended Response Sheet)
(6) None

PHILOSOPHY and CONTENT

'Please respond to each of the following items as you understand and have an opinion at this time using the indicated scale. Respond according to the strength of your agreement with each of the following statements. Begin each statement with the phrase, "I believe that . . .".

Darken one circle for each item.

1 - Strongly agree	2 - Agree	3 - No Opinion	4 - Disagree	5 - Strongly Disagree

28. Cooperative learning groups are an effective instructional strategy in science.
29. Almost all children can learn science.
30. Homogeneous groups (students of similar abilities) foster better learning than heterogeneous groups.
31. Open-ended projects are useful in assessing student performance.
32. Computer technology is an important tool in the science laboratory.
33. Tracking by ability encourages science for all students.
34. Science instruction should be tied to real-life applications.
35. Science requires a knowledge of the terminology of each discipline.
36. Teaching thinking skills is important in the science classroom.
37. Class instructions should not include real-life applications.
38. Curriculum should be organized around the textbook.
39. Most students understand science better with the use of hands-on investigations.
40. The important goal of science instruction is to prepare students for further study of science.
41. Well-phrased questions encourage more open-ended investigations.
42. The best use of a textbook is as a resource rather than the primary instructional tool.
43. Students learn more in heterogeneously grouped classes.
44. Cooperative learning groups are a hindrance in science instruction.
45. Auditory presentations of information (lecture) is an effective instructional strategy.
46. Computers are best used by students as tools for writing or record keeping.
47. Instruction should use a variety of alternative assessment strategies (i.e., portfolios, authentic, performance, etc.).
48. It is important that parents be involved in the science education of their children.
49. Understanding concepts rather than vocabulary should be the main purpose of science teaching.
50. Learning science is an active process.

1 - Strongly agree	**2 - Agree**	**3 - No Opinion**	**4 - Disagree**	**5 - Strongly Disagree**

51. A goal of science education is to equip students with the skills to become lifelong learners.

52. It is more important for students to learn how to work independently rather than to work with others on solving problems.

53. Science should be a "pump" and not a filter that screens students out of scientific and professional careers.

54. Students learn "how to think" regardless of the instructional strategy used.

55. A responsibility of a school science program is to ensure that all students have an opportunity to become scientically literate.

56. Learning to value science is an important educational goal.

57. A school science program has no role in students becoming confident in their own abilities to do science.

58. A responsibility of school science is to provide experiences that enable students to become confident in their own abilities to do science.

59. Although evaluation is important, it is not an integral part of daily teaching and learning science.

60. Students must learn to take responsibility for their own learning.

61. Knowledge is actively constructed by a student through a process that is individual and social.

62. Students should have a significant voice in decisions about the content and context of their work.

STAGES of CONCERNS QUESTIONNAIRE
Introduction

The purpose of this questionnaire is to determine what people who are using or thinking about using various programs are concerned about at various times during the innovation adoption process. The items were developed from typical responses of school and college teachers who ranged from no knowledge at all about various programs to many years experience in using them. Therefore, a good part of the items on this questionnaire may appear to be of little relevance or irrelevant to you at this time. For the completely irrelevant items, mark "1" on the computer answer sheet. Other items will represent those concerns you do have, in varying degrees of intensity, and should be marked higher.

For example:

This statement is very true of me at this time	1	2	3	4	5	6	7	8
This statement is somewhat true of me now.	1	2	3	4	5	6	7	8
This statement is not at all true of me at this time.	1	2	3	4	5	6	7	8
This statement seems irrelevant to me.	1	2	3	4	5	6	7	8

Please respond to the items in terms of *your present concerns*, or how you feel about your involvement or potential involvement with the **science curriculum reform**. A summary definition of this is given below. Remember to respond to each item in terms of *your present concerns* about your involvement or potential involvement with the **science curriculum reform**.

Definition: Science Curriculum Reform

Science literacy is a central goal of the National Education Goals. Studies since the 1980s on the status of United States science education have focused attention on the need for widespread reform in order to make science literacy a reality for all students. Basic philosophical premises of the curriculum reform include the following:

- science is for all students,
- setting science standards provides a valuable resource for improved instruction,
- students learn by "constructing" knowledge,
- students learn more when they are actively engaged in the learning process,
- assessment is an integral part of instruction,
- students need to become problem solvers,
- instruction should focus on the essential key concepts of science and on teaching them more effectively,
- the teacher's role is changing to facilitate student learning, while the student becomes a more active learner,
- families, communities, and businesses play important roles in promoting science education,
- students need to value and see the usefulness of science, and
- students need to become confident in their own ability to do science.

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SCIENCE CURRICULUM REFORM
Stages of Concern Questionnaire—Items

1	2	3	4	5	6	7	8
Irrelevant	Not true of me now		Somewhat true of me now			Very true of me now	

63.	I am concerned about students' attitudes toward this science curriculum reform.	1	2	3	4	5	6	7	8
64.	I now know of some other approaches that might work better.	1	2	3	4	5	6	7	8
65.	I don't even know what the science curriculum reform is.	1	2	3	4	5	6	7	8
66.	I am concerned about not having enough time to organize myself each day.	1	2	3	4	5	6	7	8
67.	I would like to help other faculty in their use of the science curriculum reform.	1	2	3	4	5	6	7	8
68.	I have a very limited knowledge about the science curriculum reform.	1	2	3	4	5	6	7	8
69.	I would like to know the effect of reorganization on my professional status.	1	2	3	4	5	6	7	8
70.	I am concerned about conflict between my interests and my responsibilities.	1	2	3	4	5	6	7	8
71.	I am concerned about revising my use of the science curriculum reform.	1	2	3	4	5	6	7	8
72.	I would like to develop working relationships with both our faculty and outside faculty using this science curriculum reform.	1	2	3	4	5	6	7	8
73.	I am concerned about how the science curriculum reform affects students.	1	2	3	4	5	6	7	8
74.	I am not concerned about this science curriculum reform.	1	2	3	4	5	6	7	8
75.	I would like to know who will make the decisions in the science curriculum reform system.	1	2	3	4	5	6	7	8
76.	I would like to discuss the possibility of using the science curriculum reform.	1	2	3	4	5	6	7	8
77.	I would like to know what resources are available if we decide to adopt this science curriculum reform.	1	2	3	4	5	6	7	8
78.	I am concerned about my inability to manage all the science curriculum reform requires.	1	2	3	4	5	6	7	8
79.	I would like to know how my teaching or administration is supposed to change.	1	2	3	4	5	6	7	8
80.	I would like to familiarize other departments or persons with the progress of this science curriculum reform.	1	2	3	4	5	6	7	8
81.	I am concerned about evaluating my impact on students.	1	2	3	4	5	6	7	
82.	I would like to revise the science curriculum reform's instructional approach.	1	2	3	4	5	6	7	8

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SCIENCE CURRICULUM REFORM

1	2	3	4	5	6	7	8
Irrelevant	Not true of me now		Somewhat true of me now			Very true of me now	

83. I am completely occupied with other things. 1 2 3 4 5 6 7 8

84. I would like to modify our use of the science curriculum reform based on the experiences of our students. 1 2 3 4 5 6 7 8

85. Although I don't know about this science curriculum reform, I am concerned about things in the area. 1 2 3 4 5 6 7 8

86. I would like to excite my students about their part in this science curriculum reform. 1 2 3 4 5 6 7 8

87. I am concerned about time spent working with nonacademic problems related to this science curriculum reform. 1 2 3 4 5 6 7 8

88. I would like to know what the use of the science curriculum reform will require in the immediate future. 1 2 3 4 5 6 7 8

89. I would like to coordinate my effort with others to maximize the science curriculum reform's effects. 1 2 3 4 5 6 7 8

90. I would like to have more information on time and energy commitments required by this science curriculum reform. 1 2 3 4 5 6 7 8

91. I would like to know what other faculty are doing in this area. 1 2 3 4 5 6 7 8

92. At this time, I am not interested in learning about this science curriculum reform. 1 2 3 4 5 6 7 8

93. I would like to determine how to supplement, enhance, or replace the science curriculum reform. 1 2 3 4 5 6 7 8

94. I would like to use feedback from students to change the science curriculum reform. 1 2 3 4 5 6 7 8

95. I would like to know how my role will change when I am using the science curriculum reform. 1 2 3 4 5 6 7 8

96. Coordination of tasks and people is taking too much of my time. 1 2 3 4 5 6 7 8

97. I would like to know how this science curriculum reform is better than what we have now. 1 2 3 4 5 6 7 8

98. Please write one or two paragraphs on the Open-Ended Response Sheet for the following:
When I think about my involvement with the science curriculum refom I am concerned about: ____

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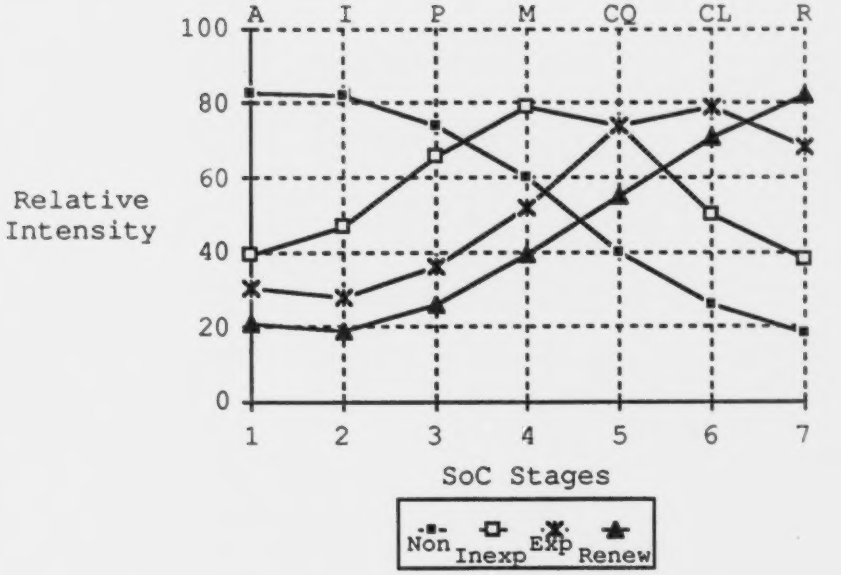
Appendix B

SoC Profile Example



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[a] A = Awareness; I = Informational; P = Personal; M = Management; CQ = Consequence; CL = Collaboration; R = Refocusing; Non = Nonuser; Inexp = Inexperienced User; Exp = Experienced User; Renew = Renewing User.

Figure 1. Hypothesized development of stages of concern[a]
(Adapted by permission from Hall & Hord, 1987, p.62)

Appendix C

Stages of Concern as They Relate to New Directons in Mathematics Education

Gann, J. H. (January, 1993). Making Change in Schools. *Arithmetic Teacher*, 296-289.

FIGURE 1

Stages of Concern as They Relate to New Directions in Mathematics Education

Stages of concern	Typical statements	Expressions of concern	Intervention strategies a change facilitator can take
Stage 0 Awareness concerns	I am not concerned about the new directions in mathematics education.	There is little concern about, or involvement with, the new directions in mathematics education.	1. Involve teachers in discussions and decisions about the new directions in mathematics education and their implementation. This strategy will include providing overviews of the *Curriculum and Evaluation Standards for School Mathematics* (NCTM 1989) and the *Professional Standards for Teacher Mathematics* (NCTM 1991). 2. Share information that will arouse interest but not be overwhelming. 3. Acknowledge that a lack of awareness is expected and reasonable and that no questions about the new directions in mathematics education are foolish. 4. Encourage sharing of information among nonusers and those who are at other stages of implementing the new directions in mathematics education.
Stage 1 Informational concerns	I would like to know more about the new directions in mathematics education.	Concerns focus on getting a general awareness of the new directions in mathematics education and learning more details. The individual is interested in such aspects as general characteristics, effects, and requirements for implementation.	1. Provide clear and accurate information about the new directions in mathematics education. Teachers may want to read some or all of the *Curriculum and Evaluation Standards for School Mathematics* (NCTM 1989) and the *Professional Standards for Teaching Mathematics* (NCTM 1991). 2. Use a variety of ways to share information—verbally, in writing, and through any available media. Communicate with individuals and with small and large groups. 3. Have users who have begun implementing the new directions in mathematics education in other sites (e.g., classrooms, schools) visit nonusers and vice versa. 4. Help teachers see how the new directions in mathematics education relate to current practices in terms of similarities and differences. 5. Be enthusiastic and highlight the visibility of others who also are excited about implementing the new directions in mathematics education.
Stage 2 Personal concerns	How will the new directions in mathematics education affect me?	The individual is uncertain about the demands of implementing the new directions in mathematics education, his or her role in relation to the reward structure of the organization, decision making, and considerations of potential conflicts with existing structures or personal commitment. Concerns about financial or status implications for self and colleagues may also emerge.	1. Take time to address the personal concerns. Legitimize the existence and expression of personal concerns. Knowing that these concerns are common and that others have them can be comforting. 2. Use personal notes and conversations to provide encouragement and reinforce personal adequacy in being able to address the new directions in mathematics education. 3. Connect teachers at this stage with others whose personal concerns have diminished and who will be supportive. 4. Show how the new directions in mathematics education can be implemented progressively over time rather than all at once in one *big* leap. It is important to establish expectations about what is attainable. 5. Do not push the implementation of the new directions for mathematics education. Provide encouragement and support while maintaining expectations.

continued

FIGURE 1 (CONTINUED)

Stages of concern	Typical statements	Expressions of concern	Intervention strategies a change facilitator can take
Stage 3 Management concerns	I seem to be spending all my time preparing and managing my instruction in order to implement the new directions in mathematics education.	Concerns focus on the processes and tasks of implementing the new directions in mathematics education and the best use of information and resources. Issues related to efficiency, organization, management, scheduling, and time are utmost.	1. Clarify the components of the new directions in mathematics education. Focus on a specific area for change. Information about how different configurations relate to a specific area is helpful here. 2. Focus on providing answers to specific "how to" issues and give exact and practical solutions to logistical problems that contribute to management concerns. 3. Help teachers identify sequences of specific activities and set timelines for accomplishing movement toward implementing new directions in mathematics education. 4. Pay attention to the immediate demands involved in the implementation program, avoiding consideration of such things as future impact.
Stage 4 Consequence concerns	How is my implementation of new directions in mathematics education affecting my students? In what ways might I refine what I'm doing to have more impact?	Concerns focus on the impact of implementing the new directions in mathematics education on students within his or her most immediate sphere of influence. The focus is on the relevance of the new directions in mathematics education for students, evaluation of student outcomes, and changes needed to improve student outcomes.	1. Provide teachers with opportunities to visit other settings where new directions in mathematics education are being implemented and to attend relevant conferences. 2. Continue to give individuals at this stage positive feedback and needed support. 3. Find opportunities for teachers at this stage to share their knowledge and skills with others. 4. Share with these persons information pertaining to new directions in mathematics education.
Stage 5 Collaboration concerns	How can I coordinate what I am doing in implementing new directions in mathematics education with what others are doing?	Concerns focus on coordination and cooperation with others in implementing the new directions in mathematics education to meet the needs of students better.	1. Provide these individuals with opportunities for developing the skills needed to work collaboratively. 2. Devise ways to bring together people, both within and outside of a school/school district, who are interested in working collaboratively. 3. Work with collaborators to establish reasonable expectations and guidelines for their collaborative efforts. 4. Involve these people in providing technical assistance to others who are in need of assistance. 5. Encourage, but don't attempt to force, collaboration.
Stage 6 Refocusing concerns	I have some ideas about what might work better in terms of implementing new directions in mathematics education. I believe that I can identify other ways than what I am doing that will work even better.	Concerns focus on exploring the more universal benefits from implementing the new directions in mathematics education, including the possibility of major changes or replacement with more powerful alternatives. Individuals have definite ideas about alternatives to the proposed or existing forms for implementing new directions in mathematics education.	1. Respect and encourage the interests these people have in finding other and better ways to implement the new directions in mathematics education. 2. Help these individuals channel their ideas and energies; act effectively on their concerns for program involvement. 3. Be aware of and willing to accept that these people may replace or significantly modify the existing strategies for implementing new directions in mathematics education.

Appendix D

Intervention Taxonomy